APPLIED HYDRAULICS

AUGUST 1955

THE MAGAZINE OF
FLUID POWER
INCLUDING AIR CONTROLS
AND AIR CIRCUIT DESIGNS
• ELECTRICAL CONTROLS •

How to Evaluate Fluid Performance . . . page 43

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How to Select Fluid Lines

FRANCHISE CIRCULATION

For more information about
THE MASTER CATALOG OF FLUID POWER PRODUCTS
see page 75

SPECIFICALLY ENGINEERED...
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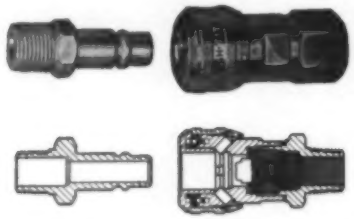
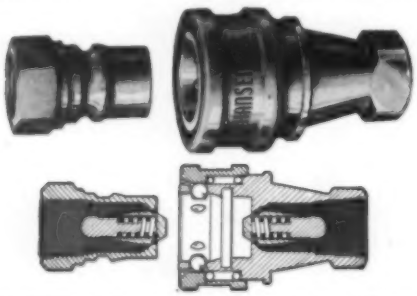
FOR EACH PARTICULAR
TYPE OF APPLICATION

HANSEN
QUICK-CONNECTIVE COUPLINGS



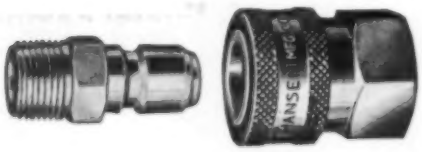
ONE-WAY SHUT-OFF
Shuts off one side of line

Gives quick connection and disconnection, with instant automatic flow or shut-off. To connect Coupling and open line to flow of fluid, merely push Plug into Socket. To disconnect, a slight pull on sleeve releases Plug and shuts off supply end of line.



TWO-WAY SHUT-OFF
Shuts off both sides of line

To connect, pull back sleeve and push Plug into Socket. Identical torpedo type valves permit free flow of gas or liquid through Coupling. To disconnect, pull back sleeve . . . Coupling immediately disconnects, valves automatically seal both ends of line. Female pipe thread connections from ⅛" to 1". Available in brass or steel.



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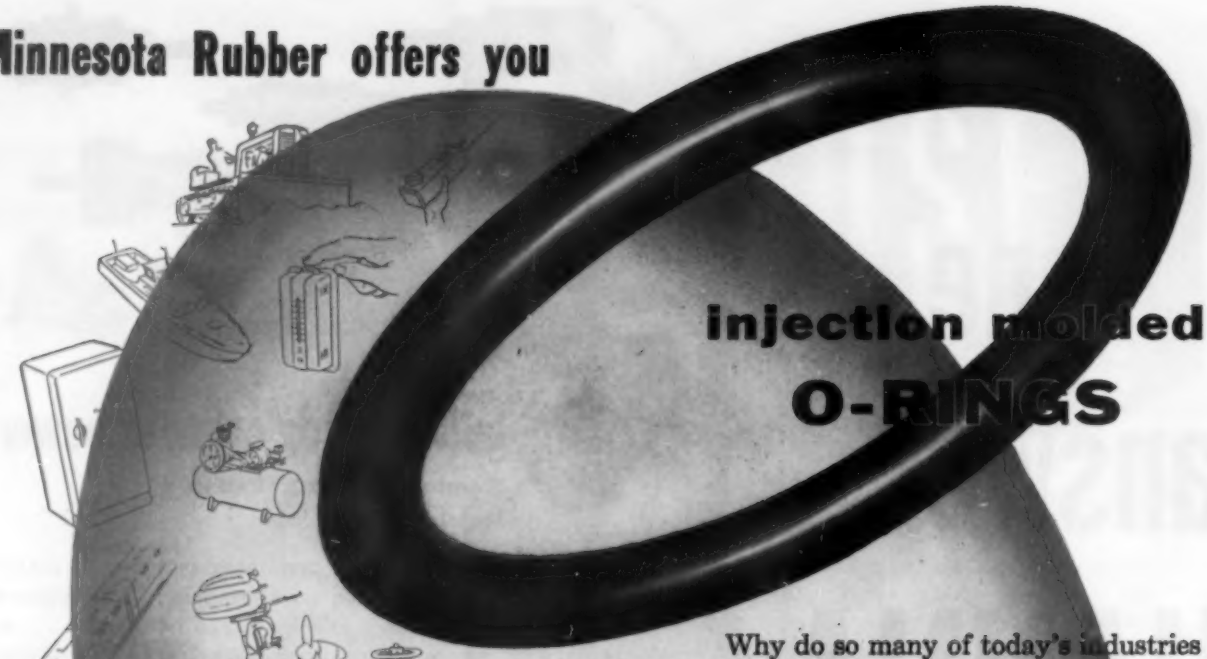

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VOLUME 8 NUMBER 8

AUGUST 1955

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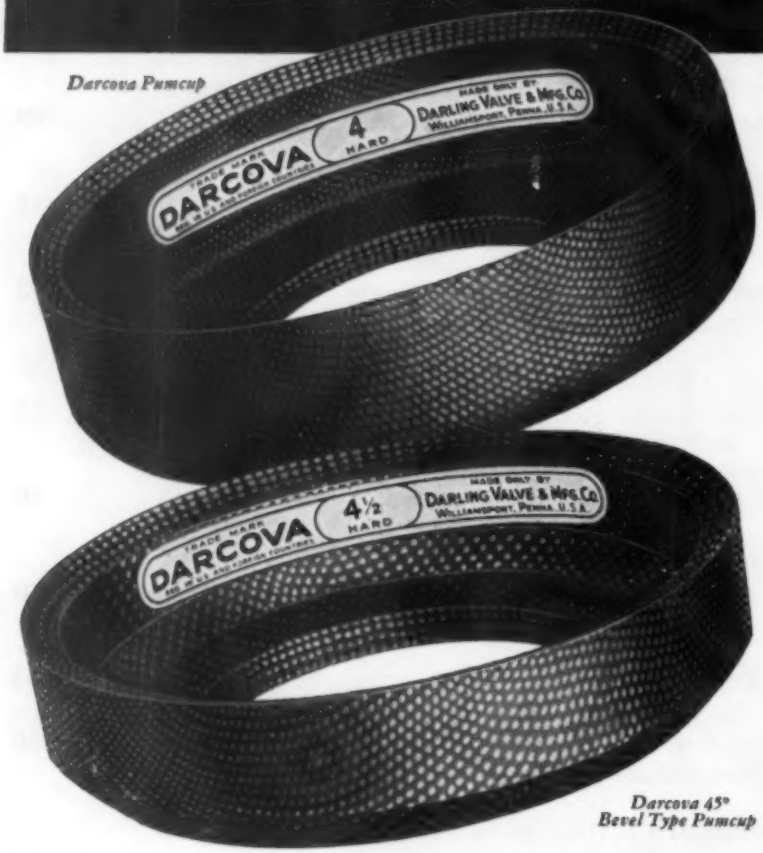

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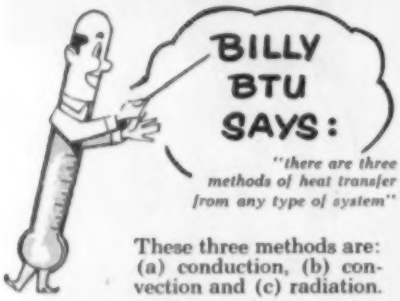
Young Heat Transfer News

YOUNG RADIATOR COMPANY, RACINE, WIS.

Moslo Injection Molders Use Young Heat Exchangers to Cool Hydraulic Oil



These three methods are: (a) conduction, (b) convection and (c) radiation.

Heat transfer by conduction exists when heat flows within a body from one region of high temperature to another region of lower temperature by simple molecular communication. The amount of heat which can be transferred by conduction is dependent on the temperature difference, thermal conductivity of the material through which the heat is being conducted, the distance between the hot source and the cold sink, and the cross sectional area for heat flow.

Transfer of heat by forced convection depends on the velocity of the fluids over the surface through which heat is conducted . . . by the shape of the surface, by the area through which heat is conducted . . . and by various properties of the fluid as well as temperature difference.

The third general means of heat transfer is radiation. Here heat flows from the body of the higher temperature to the body of the lower temperature through space without any medium within the space. For further details on this subject write for free bulletin: "Heat: Forced Convection Removal From Industrial Hydraulic Circuits" to Young Radiator Company, Dept. 445H. Racine, Wis.

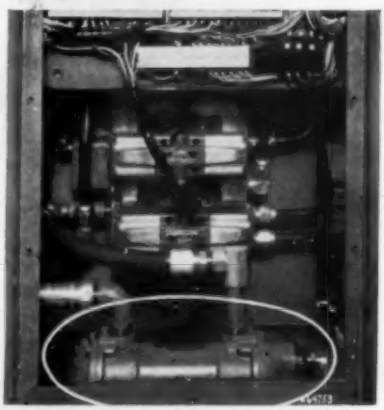
Front view Moslo plastics injection molder

Moslo Machinery Company, Cleveland manufacturer of plastics injection molding machines, specifies Young type "F" fixed tube bundle Heat Exchangers to dissipate heat generated in the hydraulic fluid during molding operations.

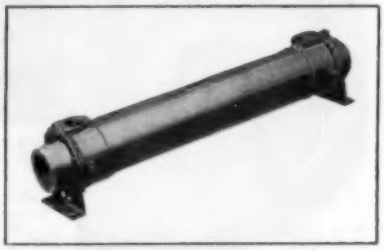
The Moslo plastics injection molder forces liquid plastic under high pressure into the mold chamber. Hydraulic fluid, pumped to high pressures, flowing through valves, relief valves, piping and cylinders increases in temperature to the point where equipment does not perform properly. Young heat exchanger controls this temperature to optimum operating limits.

Young Coolers use a minimum of cooling water passing through the tubes. They are engineered to minimize pressure drop in the hydraulic fluid circulating through the shell side of the 2-pass exchangers. Hydraulic fluid operating temperatures are thus maintained at approximately 115° F., throughout continuous operation of the Moslo molders.

Beneficial effects of cooling hydraulic oil are the maintenance of viscosity, eliminating the possibility of breakdown and the prevention of harmful carbon deposits in pumps.



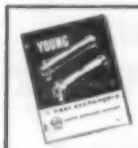
Rear of Moslo Molder, Cooler Circled



Young Radiator Company Heat Exchanger

Young Radiator Company Heat Exchangers are available for quick delivery in fixed or removable tube bundle models for fresh or salt water applications. High heat transfer rates per unit volume of space make Young exchangers the economical answer for simple cooling of oil or water, to cooling or heating of special liquids or gases.

For further details on Young Heat Exchangers see your nearest Young Representative, or write the Young Radiator Company, Dept. 445-H, Racine, Wisconsin.



NEW FIXED TUBE BUNDLE HEAT EXCHANGER CATALOG READY

A complete description of stock and specially engineered Young Radiator Company Type "F" Fixed Tube Bundle Heat Exchangers is given in the newly revised Catalog No. 1254. For your copy, write Dept. 445H, Young Radiator Company, Racine, Wis.

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Vickers maintains a Hydraulics Training School for engineering, maintenance and service personnel of both original equipment manufacturers and their customers. For further information, please contact Product Service Department directly.

7143

ENGINEERS AND BUILDERS OF OIL HYDRAULIC EQUIPMENT SINCE 1921

Fluid Power Lines

about Applied Hydraulics

NO MAGIC NUMBER . . . Many designers think they have proper hydraulic line sizes if flow velocities do not exceed 15 feet per second. Because "good enough" operation results in most cases when the 15 fps limit is used, it is generally applied indiscriminately. Heat, wear, oil breakdown and erratic operation are then blamed on everything but the wrong line size.

This month's lead article explains the reasoning behind the 15 fps limit and shows where it can and cannot be used. Of greater importance, this article details a selection method based on theory of fluid flow which results in optimum line sizes. Charts and tables in this article make it a valuable guide in choosing pipe, tubing and hose.

WHEN IS A PUMP NOT A PUMP? . . . Pumps are used to develop pressure and deliver oil to the work. When a pump is used for something else, is it still a pump? Don't expect an answer from us. We just posed this rather useless riddle so that we could point out Gene Brown's article in which he tells about the use of a pump to measure the torque of the electric motor which drives it. Torque measurement is made by checking the movement of the pump housing.

HYDRAULICS TO REDUCE TORQUE . . . Hydrostatic lubrication—the use of a high pressure oil film to reduce friction loads—has been under investigation for many years. Builders of heavy rotating equipment are using this technique with considerable success. Allis-Chalmers engineers, H. H. Roth and W. B. Cart, tell about their application of a small 1000 psi hydraulic circuit to reduce breakaway torque on motors weighing almost two million pounds.

PRESSURE CONTROL IDEA . . . It is fundamental that if a circuit is to be worth anything it has to meet the requirements of the work load. How designers provide the necessary speed, pressure or torque control is the key to useful application of fluid power. To provide you with another circuit idea, John Fawcett tells about a design which controls pressure for stretching steel bars in prestressed concrete.

BASE YOUR CHOICE ON PERFORMANCE . . . That's the best way to choose a hydraulic oil. But how do you check performance? Russ Hemeon's article describes a method used at Ternstedt-Trenton to compare fluids. Pump service life is an excellent gauge. With some care, an evaluating technique can be applied which gives a good indication of oil performance on equipment in your plant. Incidently, one of the charts in Russ' article needs a bit more explanation. He designates an oil used back in the 40's as "CP". In response to our request for more specs on this fluid, he says, "CP is equivalent to dromedary urine".

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To provide positive and constant fuel flow, Lear-Romec centrifugal booster pumps are used in many high altitude aircraft. They are submerged directly in the fuel tank where they separate the fluid from the troublesome vapors which are formed at higher altitudes.

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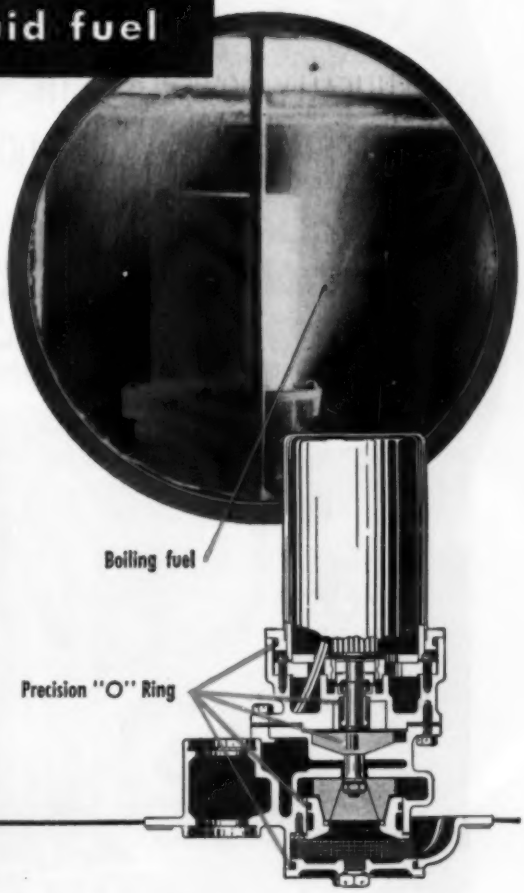

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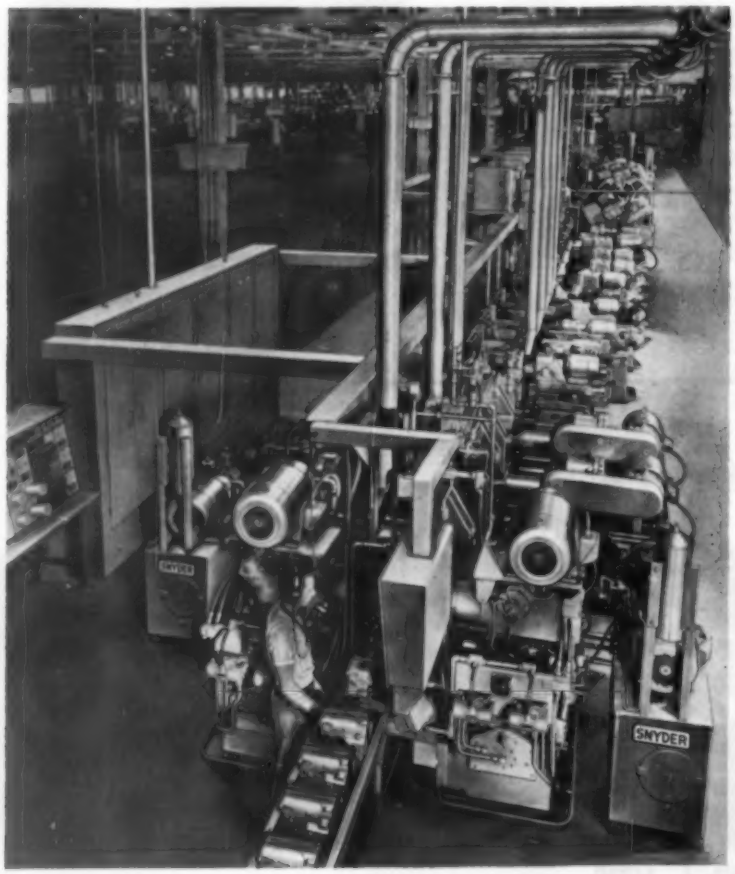
BRIEFS about fluid power

HYDRAULICALLY POWERED IN-LINE TRANSFER MACHINE PERFORMS 182 OPERATIONS

Four individual sections with a single transfer line are the features of an automatic transfer machine built by Snyder Tool & Engineering Co. 150 feet long, the machine performs the 182 milling, drilling, tapping and boring operations on a cast iron automotive automatic transmission case.

Each section can be individually controlled, loaded and unloaded. Individual transfer mechanisms are provided for use in case any section shuts down for tool changes or maintenance. Operations of all sections can be controlled by one operator if desired. The hydraulically powered, electrically controlled machine has single control panels for each section, though when one operator controls all sections, the transfer bar controls the operation of each section.



The first section, 40 feet long, has 19 stations and 10 spindles, performs milling operations. The 47 feet long second section with 31 stations and 91 spindles drills, countersinks, taps and performs some other operations on 51 holes. A variety of drilling, chamfering, tapping and counterboring operations take place on the third section which is 26 feet long, has 17 stations and 21 spindles. 24 stations and 60 spindles are on the 36 feet long fourth section. This last section performs drilling, chamfering, tapping, semi-finish, finish boring and facing operations.

The machine cycles to produce 100 cases per hour at 80 percent efficiency. ▼▼▼

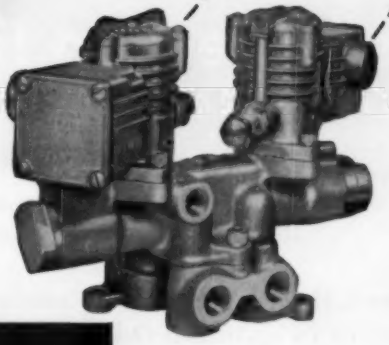
Fluid Power Publications

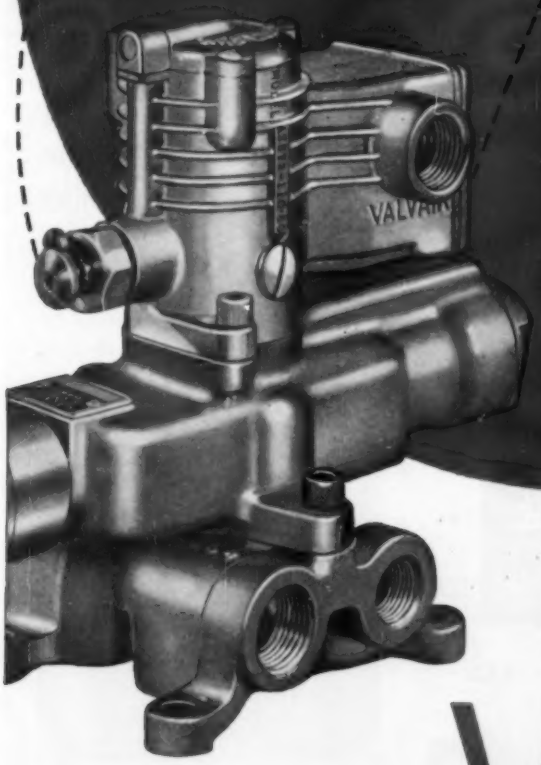
Two technical reports "Design, Operation and Maintenance of Hydraulic Equipment for Use with Fire Resistant Fluids", 20 pp, price 30 cents, and "A Glossary of Terms for Fluid Power", 11 pp, price 20 cents, have been published by the National Fluid Power Association.

Continued on page 12

DOUBLE

solenoid
pilot operated
control valve





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Valvair is proud to announce another advancement in the field of automation—The Double Solenoid Speed King Control Valve, designed especially for both the Original Equipment Manufacturer and the End User. This development proves that, more than ever before, Valvair is the name to keep in mind when you order solenoid-operated valves.

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REDWOOD CITY, CALIF. . . *Broadway and National, EMerson 6-3861*
WICHITA, KANSAS . . . . *519 South Broadway, WIchita 2-6971*

BRIEFS continued

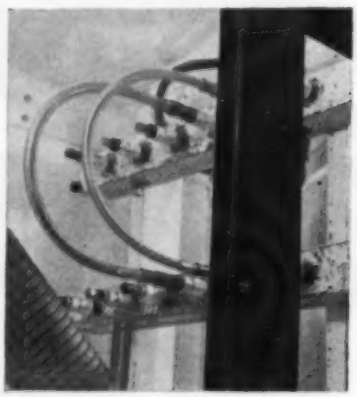
With the increased use of fire resistant fluids in hydraulic systems, the technical report on these fluids is very timely. The booklet covers water base and non-water base fire resistant fluids, their characteristics, viscosity, effects on seals, packings, hose, etc. Tables are included to evaluate and compare several types of synthetics showing their fire resistance and other qualities. Some pages are also devoted to a comprehensive bibliography on hydraulic fluids and their application.

The Glossary of Terms is the first edition under a plan, whereby it is hoped to issue revised editions periodically as the need develops. Written in simple language, it covers definitions from the Accumulator to Valve, Unloading.

Both reports, which are welcome additions to hydraulic reference literature, are available from the NFPA, 1618 Orrington Avenue, Evanston, Illinois. ▼▼▼

New Hose for High Temperature Hydraulics

A new line of hydraulic hose made with a Teflon-compounded inner tube has been developed to operate at 3000 psi and temperatures never before demanded in



hydraulic systems. Because of its complete chemical inertness this new hose will withstand all presently known synthetic and petroleum based hydraulic fluids. Basic development problems such as ma-

Continued on page 14

It's too hot in August to read a long story . . .

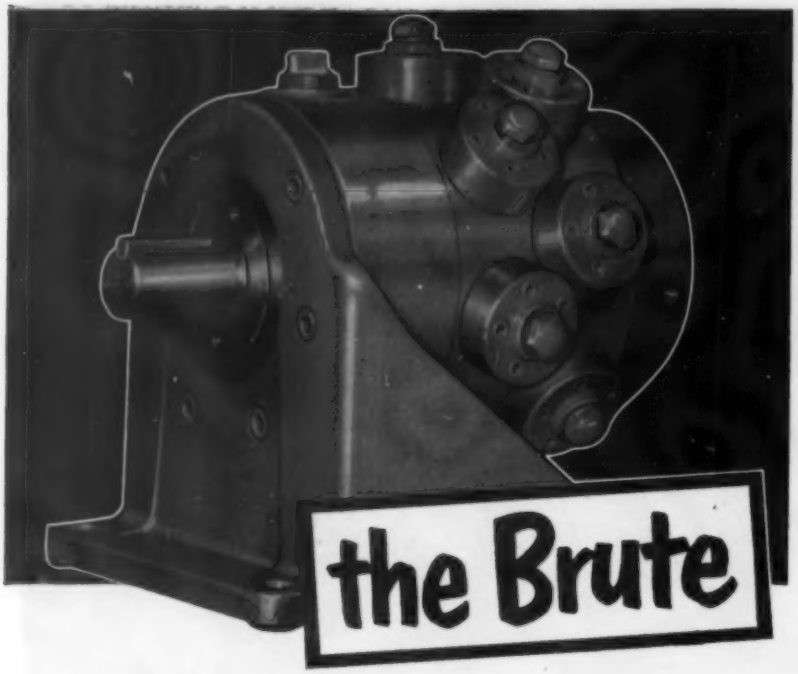
BUT HERE'S A MAJOR POINT TO REMEMBER:

For precision, electrically interlocked pneumatic circuits, the Bellows Air Motor with momentary contact low voltage electrical control offers the simplest and most positive approach to air design problems.

For the detailed story write for Bulletin CL-50

The Bellows Co.

8704



This Series C SECO heavy duty pump has been aptly termed the "Brute" of all hydraulic pumps. The Brute is the rugged, revolutionary answer to high horsepower, high pressure demands. It opens new horizons in the use of oil hydraulic power.

Pressure is developed *within hollow pistons*—a patented feature of SECO pumps—making possible extremely high pressures without loss of mechanical efficiency. Each piston assembly is completely surrounded by high pressure lubrication and literally floats in a hydrostatic film of oil during its power stroke. *Fluid timed* ball check valves insure quiet and efficient operation at all pressures.

The Brute is at present made in two models, with the following characteristics:

MODEL	C-11	C-5
MAX. PRESSURE-SPOT RATING—PSI	5,000	10,000
MAX. PRESSURE-CONT. RATING—PSI	4,000	6,000
DELIVERY AT MAX. PRESS. G.P.M.	10	5
SPEED.....R.P.M.	1170	1170
H.P. INPUT AT MAX. PRESSURE	35	38

If you are interested in high horsepower, high pressure hydraulic power, please send for complete information on SECO Series C Pumps.

Simplex Engineering Co., Zanesville, Ohio

SECO

SIMPLEX ENGINEERING CO.
Zanesville, Ohio

Please send me complete information on SECO Series C pumps.

Name_____ Title_____

Company_____

Address_____

BRIEFS / continued

terial selection for the hose liner and outer reinforcement were successfully worked out. A fitting design will enable fittings to seal perfectly without disengaging from the hose at any combination of temperature and pressure within the specified ratings.

This new type hose, which is urgently needed in the aircraft industry as a result of increasingly higher speeds and temperatures at which aircraft operate, was developed by Resistoflex Corporation.

▼▼▼

Electro-Pneumatic Nutsetter Speeds Automobile Assembly

Designed to tighten nuts on front end suspension assemblies, Cleco Division of Reed Roller Bit Company, developed this new double-torque four spindle electro-pneumatic nutsetter. The machine meets

two different torque requirements of assorted front end suspension units.

Handles with push buttons located on each side of the nutsetting unit operate the torque selection. Pressing the right hand button provides torque from 55 to 65 foot pounds, the other produces a torque of from 80 to 90 foot pounds. The nut setting unit consists of four air motors mounted on a magnesium body which is trunnion mounted in a small struc-

Continued on page 16

on your Hydraulic Tubing problems

Need special service on a hydraulic tubing problem? Or special sizes and shapes made to your specifications? Then we're the people to see.

We're geared for service. Our research, production and sales teams are small enough to give you the kind of personalized service and teamwork that gets results when nothing else can. And they're big enough to achieve volume production in a hurry at our modern, versatile plant.

Whatever the type of cold drawn, seamless tubing you require, you'll find that Summerill is completely equipped to produce it to *your* specifications. What's more, every operation at Summerill is laboratory controlled to give you consistent peak quality of product with every tube.

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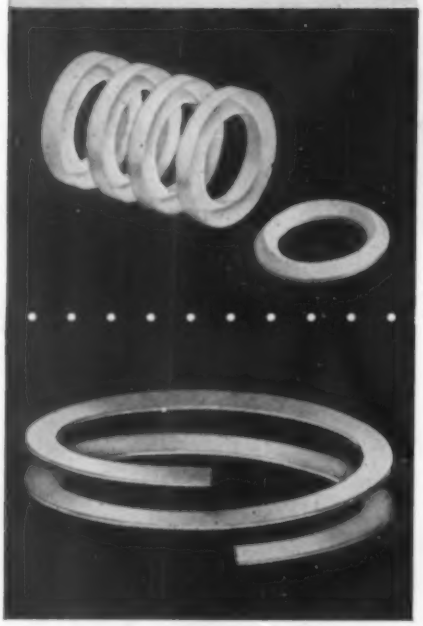
finest hydraulic packing for plane or plant...

Chemiseal hydraulic packings ... made of chemically impervious duPont TEFLON—have zero swelling in all hydrocarbons, new synthetic hydraulic fluids and solvents. Require no chemical inspection. Unsurpassed antifriction properties, are tough, resilient, non-flammable, long wearing. Wide service temperature range from minus 110°F to plus 500°F.



Chemiseal V-Type packings are ideal for either manual or automatically operated valves. Seal with low gland pressure and operating torque. Square end TEFLON adaptors are available if required. Catalog TP-1053.

Chemiseal Back-up rings prevent "O"-ring extrusion and greatly lengthen their life. Spiral, solid and split ring types are available in all commercial and AN sizes. Catalog OB-1152.

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BRIEFS / continued

tural aluminum frame. A valve and regulator unit suspended above the machine carries conecting air and electrical lines. The nut setting unit is suspended from a counterbalance.

▼▼▼

1955 NCIH

Subjects to be covered at the 11th National Conference on Industrial Hydraulics—Chicago, October 27-28—will include: Hydraulic Fluids; Presses; Automotive; Pumps; Components and Accessories; Pneumatics; Mobile; Machine Tools; and Aircraft Controls.

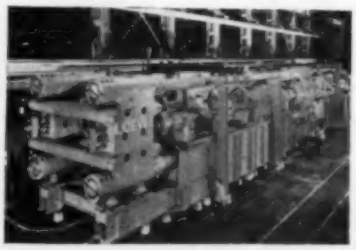
A feature of this years conference will be a general session on "Application of Electronic Analog Computers to Hydraulic Problems".

More information and program data will be published in the next issue of APPLIED HYDRAULICS.

▼▼▼

Where's The Big Press Program Now?

One of the largest extrusion presses ever built, as part of the U. S. Air Force's heavy press program, has been completed. All of the ten presses which remained on the program will be installed during this year.



This 8,000 ton hydraulic extrusion press, designed and engineered by Loewy-Hydropress, Inc., built by Nordberg Manufacturing Co., will be installed at Kaiser Aluminum's Halethorp, Maryland, plant.

Weighing approximately 4,000,000 pounds, the press is almost 174

Continued on page 18

You're covered across the board

when you use General Controls' line of quality automatic controls

More and more designers find one simple rule short-cuts their control problems with a quick solution: "Check General Controls first!" For the chances are the complete GC line has the perfect answer to your problems whether it's a time switch or thermostat, a midget solenoid or mighty hydramotor. Get acquainted with the branch office (one of 40) nearest you . . . one source—one responsibility—near at hand—at your service.

K-21 MAGNETIC STOP VALVE

Packless—2 way—normally closed. For air, gas, steam, water, oil, corrosive fluids. Pressures to 300 psi.—Forged brass body. Stainless steel or soft seat.

K-27 MAGNETIC VALVE

Stainless steel for high sulphur fuels, syrups, juices, acids, alkalis, etc. Pressures to 300 psi. Midget size. Multi poised—operates in any position.

K-10 MAGNETIC VALVE

Lever action for higher seating pressure. Excellent general purpose valve for primary fuel, feed water, steam, air. (300 psi max. operating pressure differential.)

K-15 MAGNETIC VALVE

Piloted piston design. Large flow capacity with low pressure drop. For air, gas, steam, oil derivatives. Versatile—with 3 coil classes, 5 seat variations.

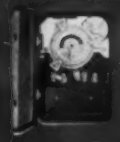
K-123 MAGNETIC VALVE

3 way—for normally open or normally closed directional control and mixer applications—on pneumatic or hydraulic operated devices, machine tools, etc.

K-273 MAGNETIC VALVE

3 way flow or mixer type. Compact, multi poised. For air, water, hydraulic fluids—charging or emptying systems. Normally open or closed. Choice of flow patterns.

TIME SWITCHES



Wide selection for domestic and commercial use—spring wound or motor driven, normally open or closed. For ventilating, lighting, refrigeration, etc.

HYDRAMOTORS

Wide range of types in complete range of pipe sizes and body styles to provide safe, dependable, durable answer to all liquid transfer problems.

AIR MOTOR VALVES

Air-operated diaphragm valve for modulating control. Normally open or closed, 3 way, or slide gates. Selection of various inner valves, body sizes and connections.

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Flex-O-Tube will help you determine the assembly needed or work to your own specifications. In either case, modern facilities and latest inspection techniques assure you a uniformly high quality product delivered promptly.

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Flex-O-Tube hose is also supplied in bulk coils with reusable fittings for field assembly. Complete range of sizes and types.

If you use flexible hose in your product or for replacement in your plant, it will pay you to specify Flex-O-Tube. For here is a name that has stood for finest quality and dependable service for more than a quarter of a century.

In the development of new uses for flexible hose, Flex-O-Tube provides you with dependable experience in the field. When used for replacement in industrial maintenance, Flex-O-Tube provides you with a complete range of products that are easy to assemble and long on performance.

Whatever your needs, why not discuss them with the local Flex-O-Tube field engineer. You'll find there are many good reasons why industry has relied on Flex-O-Tube for miles and miles of flexible hose products.

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Flex-O-Tube Co. (Canada) Ltd., Windsor, Ontario

BRIEFS continued

feet long with hydraulic equipment, controlling mechanism and run out tables. Water with a small percent of protective oil is the hydraulic medium. Stroke of the main cylinders is 20 feet and of mandrel cylinders is 17 feet 2 inches. Operating pressure is 4500 psi. ▼▼▼

Universities To Display Research Results

Eight universities will make a joint presentation of their latest research at the Production Engineering Show in Chicago. This is the first time an exhibit of such a nature will be on view to industrial executives.

The universities represented are Case Institute of Technology, Cornell University, Illinois Institute of Technology, University of Illinois, Massachusetts Institute of Technology, University of Michigan, Northwestern University and Ohio State University.

Among the exhibits, some of which will show latest production techniques, will be a hydraulic analog computor for studying air conditioning loads, apparatus for simple, accurate measurement of the density of fluids, and the first operating scale model of a nuclear reactor for industrial uses ever shown publicly. ▼▼▼

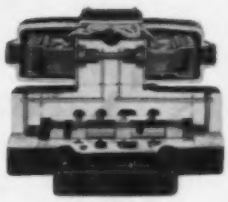
ASLE-ASME Lubrication Conference Stresses Research

Twenty-six papers have been submitted to the second jointly sponsored Lubrication Conference to be held October 10-12 at Indianapolis. The three days will be devoted to the presentation and discussion of research papers. The Conference will be divided into these sessions: Bearing Instability; Recent Studies in Hydrodynamic Lubrication; Lubricants; Rolling Contact Bearings; and Boundary Lubrication. ▼▼▼

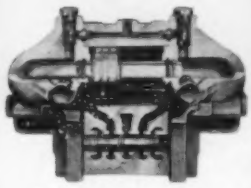
Continued on page 21

NEW RACINE FLUID MOTOR

PROGRAMMED RESEARCH FOR PRODUCTION PROGRESS

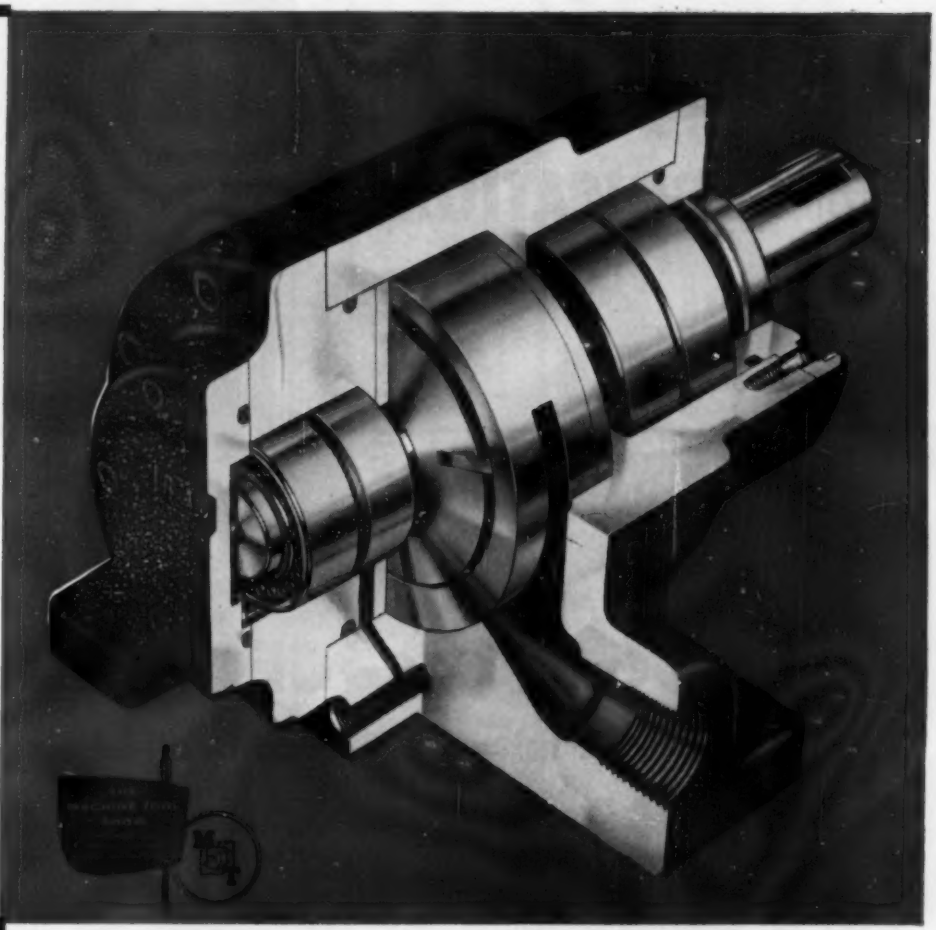


Twin Solenoid Pilot Operated 4-Way Valve



Hydraulic Pressure Booster Pressures to 5000 p.s.i.

Hydraulic Power Unit Designed for your needs



A vane type constant displacement Fluid Motor that features simplicity and compactness of design. It is ruggedly built for continuous operation at pressures up to 1500 p.s.i. and Speeds of 50 to 3500 rpm.

Torque is constant at any degree of rotation. Heavy bearing construction will support overhung loads equal to full torque on a 6" diameter wheel plus a 100 pound external end thrust.

Write for prices and complete information on RACINE'S full line of Hydraulic Equipment. Address **RACINE HYDRAULICS & MACHINERY, INC.,** 2074 Albert Street, Racine, Wisconsin.

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Celanese* CELLULUBE*s

synthetic lubricants in controlled viscosities

Celanese CELLULUBES have been developed to meet the pressing need for non-carbon-forming lubricants that are both safe and efficient.

These synthetic lubricants are phosphate esters—straight chemical compounds controlled to specification viscosities. They have excellent lubricity . . . are non-corrosive, non-reactive, non-oxidizing in air compressor service.

CELLULUBES are *non-petroleum* oils. They greatly reduce the formation of carbon deposits, a prime source of air compressor explosions and fires.

CELLULUBES have been job-tested for 3 years in actual compressor installations. Evaluate them in your own operation. Use coupon below to order samples and complete technical data.

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Please send me sample and technical bulletin on Cellulube fire-resistant Synthetic Lubricants for air compressor service.

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...is a vertical, automotive type high pressure pump designed to meet the need for an outstanding hydraulic power source. The new tall spacer block provides a large unobstructed hand-hole opening. Metal-to-metal plungers and liners may now be even more quickly and easily changed to meet varying volumes and pressures.

Economical to install...easy to maintain

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Your local KOBE distributor *knows* hydraulics, *knows* hydraulic application, *knows* hydraulic pumping systems—and is chosen for his ability to engineer the complete job for you. His ability plus KOBE equipment means a better, more profitable application, every time.

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BRIEFS continued

Die Casting Engineers Form New Society

To foster and further technological advances in the field of die casting, finishing of metals, and die molding of plastics and powdered metals, the Society of Die Casting Engineers has been formed. The society's main objective will be the exchange, accumulation and dissemination of the latest information, and knowledge in the arts and sciences of die casting and related arts. National headquarters are in Detroit, where the first Chapter of the society was formed. Harris Shimel of Chevrolet—Bay City was elected president.

▼▼▼

Industrial Exposition Offers Helicopter Service

Executives who come to see the Production Engineering and Machine Tool Shows in Chicago in September will be able to beat today's traffic problems with a scheduled helicopter service. This shuttle service, the first of its kind to be arranged for exposition visitors, will carry the businessmen between the Navy Pier and the International Amphitheatre, where these shows are held.

▼▼▼

FUTURE EVENTS

September 6-17: The National Machine Tool Show at the International Amphitheatre and the Production Engineering Show at the Navy Pier, will be held simultaneously in Chicago.

October 27-28: The Eleventh National Conference on Industrial Hydraulics will be held at the La Salle Hotel, Chicago. For reservations write to C. A. Arents, Secretary, Illinois Institute of Technology, Technology Center, Chicago 16.

November 2-4: Fall Meeting of the National Fluid Power Association will be held at the Edgewater Beach Hotel, Chicago.

▼▼▼

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NO LIMIT

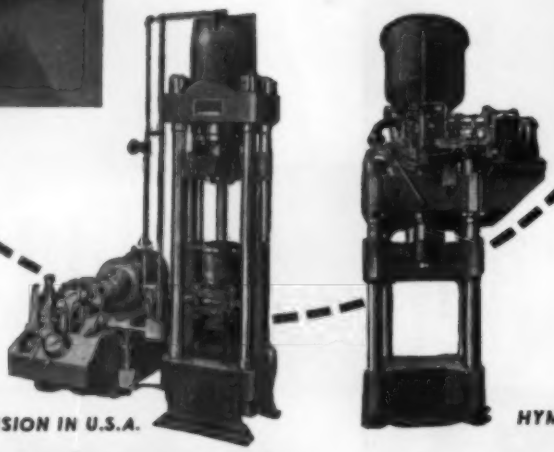
TO THE APPLICATION OF ELECTRAULIC HIGH SPEED PUMPS AND AUTODRAULIC CONTROL VALVES

All over the world, Electraulic high speed pumps and Autodraulic control valves (no solenoids) give consistent performance over a wide range of applications. A direct hydraulic system powered by Electraulic pumps and operated by the Autodraulic push-button control system is an independent unit, unaffected by the demands of other machines, giving any desired pressure at fingertip control—it cannot fail to give increased efficiency and economy in *your* plant.

FORGING IN SWEDEN

IN-LINE PLUNGER PUMP

Electraulic Twin Straight-in-Line Plunger Pump, mounted in a steel bed-plate tank.



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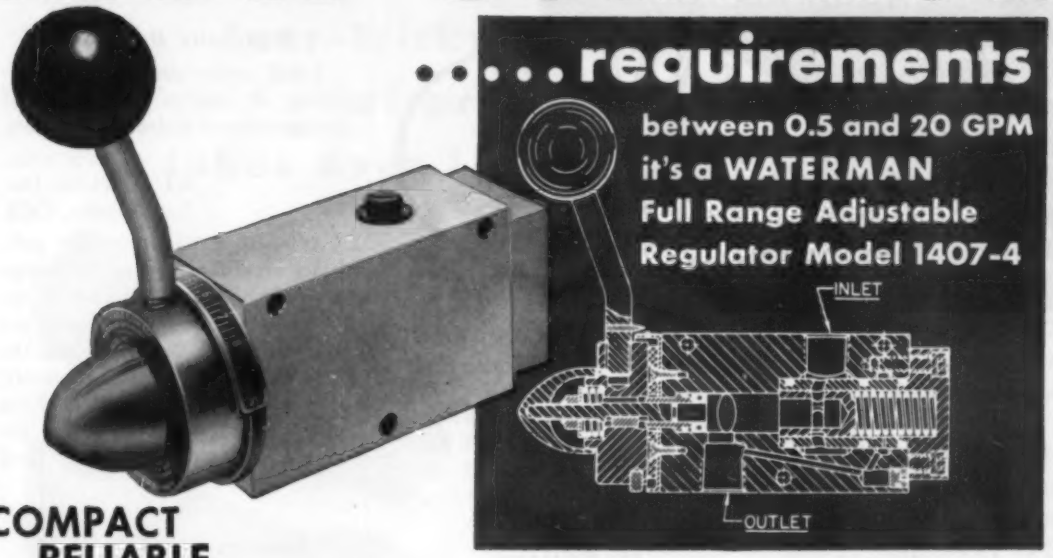
between 0.5 and 20 GPM
it's a WATERMAN
Full Range Adjustable
Regulator Model 1407-4



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- Minimum to maximum flow adjustment obtained by 180° handle rotation.
- Flow rate changes easily accomplished under any conditions of pressure or back pressure.
- Adjustable handle tension eliminates need for wrenches and locking levers for changes in flow setting.
- Ideally suited for installations requiring frequent changes in operating speeds or throttling control during the machine cycle.
- Choice of control—either right or left rotation of control handle.
- Multiple control—with right and left hand rotation operator can control two operations simultaneously.
- Aluminum bodies housing steel working parts provide light weight units for easy handling and installation.

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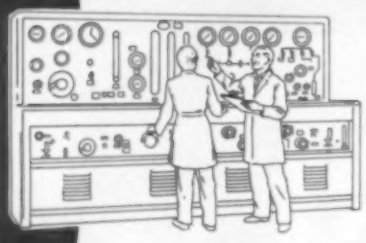
When you see the "SPRAGUE" Trade Mark on a test machine, you can be sure of accuracy, efficiency, economy and years of dependable service.

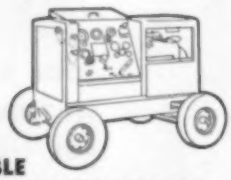
SPRAGUE ENGINEERING CORPORATION GARDENA, CALIF.

In addition to the machines shown here, SPRAGUE makes Fuel Flow and Fuel Pump Test Stands, Heating and Ventilating Test Units, High Pressure Hose Testers, Air Operated Hydraulic Boost Pumps, Filters, Cylinder type Accumulaters (3,000 and 6,000 psi.), Gage Protector Automatic Shut Off Valves and other equipment. Write for information.



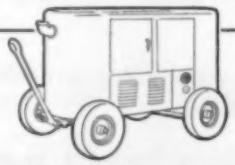
STATIONARY HYDRAULIC TEST STANDS

Tests aircraft hydraulic components, including engine driven pumps, at operating pressures up to 5000 psi. and with flows to 20 gpm. Provides multiple circuits to permit simultaneous testing of several units.



PORTABLE HYDRAULIC TEST STANDS

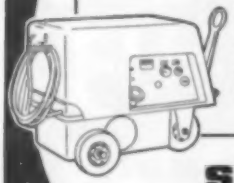
Standard units, 10 G. P. M. to 40 G. P. M. Motor or engine driven. For complete testing of aircraft hydraulic systems.



PRESSURIZED CABIN LEAKAGE TESTERS

Supply clean, filtered air under controlled pressure to locate leaks and determine leakage rate.

AIR OPERATED OIL DISPENSERS



Dispense clean, filtered oil simply, quickly, economically. One-man operation. Maximum safety.

FUEL BOOST PUMP TEST STANDS

Designed especially to test submerged fuel boost pumps. Tests both A. C. and D. C. types.

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LETTERS to the editor

Hydraulic Dashpots

I will appreciate receiving tearsheets of articles on design of pneumatic and hydraulic dashpots.

R. E. SHAFER,
R.C.A. Victor Div.
Los Angeles, Calif.

APPLIED HYDRAULICS *has published several articles on the design of hydraulic cylinders which incorporate metering needles to act as decelerating devices. Is this the type of dashpot you had in mind? We have sent you tearsheets of the article on hydraulic snubber design which appeared in the April issue.*

Readers Want Product Information

We would like information on small hydraulic drives that would be equal to ½ and 1½ hp.

DON J. LECKEY
The Lawn-All Corporation
Johnstown, Pa.

Names of several companies which make packaged drives have been sent. It may also be practical to arrange a drive for your job which uses separate pump and motor and valving.

We've encountered the problem of locating manufacturers who make small complete pumping units which would be installed in our products which are being redesigned to operate hydraulically. This unit should be one small package, having a pump with a ½ gpm output, operating in a pressure range of 50 to 100 psi, a built-in relief valve, a small reservoir, and motor of 115 volts, 60 cycle single phase characteristics. The space available to install this unit is 17" long by 7" wide by 10" high.

HARRY PAULOS
Diebold Incorporated
Canton, Ohio

Several manufacturers make a package unit which may be small

Continued on page 26

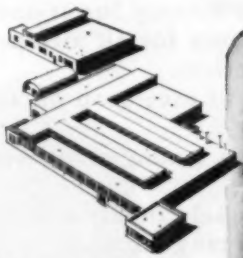
ANNOUNCEMENT!

Teer-Wickwire, manufacturer of precision parts, takes over Lindberg cylinder line

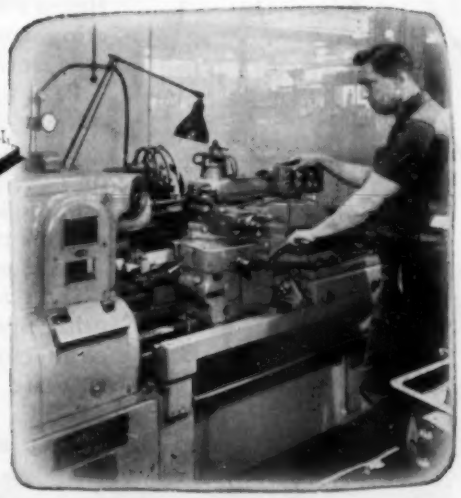
Now Lindberg Air and Hydraulic Division of Lindberg Engineering is Lindberg Air and Hydraulic Division of Teer-Wickwire & Co. Operations have been moved from Chicago to Jackson, Michigan, into a new plant devoted to cylinder manufacture.

Out of this modern 60,000 square foot plant at Jackson will come the present line of Lindberg air and hydraulic cylinders, manufactured to new standards of quality, durability and performance. In development now, and due for release soon, are revolutionary new cylinders to meet tomorrow's requirements with less bulk, less weight, less cost.

WHO IS TEER-WICKWIRE & CO.?



We are specialists in mass production of precision parts and components at low cost. We have been a contract manufacturer for the automotive industry for 25 years. We are *exclusive* suppliers of several components for some of the largest makers. Our plants are tooled with the latest machines. We combine proven production methods with rigid quality control systems to achieve high quality at competitive costs. *All of this experience now goes to work for users of air and hydraulic cylinders!*



The Monarch Tracer-type lathe pictured is typical of the modern machine tools used in our plant.

LINDBERG AIR AND HYDRAULIC DIVISION
TEER-WICKWIRE & COMPANY
Jackson, Michigan

NEW "HI-LO" SPEED COUPLERS and CONNECTORS

(HIGH VOLUME — LOW PRESSURE DROP)

"HI-LO" for *highest* air volume, *lowest* pressure drop

Better efficiency, lower operating costs for all air-operated devices.

Easy to use—snap on and off.

Swivel action saves wear on hose.

Wide selection of sizes for greater range of uses.

Leak-proof seal.

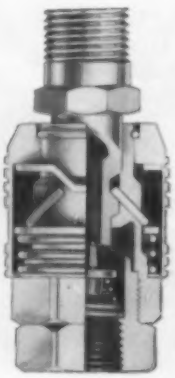
Interchangeable with many other brands of couplers and connectors.

Write for bulletin No. 5518T.

THE ARO EQUIPMENT CORPORATION
Bryan and Cleveland, Ohio

Aro Equipment of California, Los Angeles, Calif., Aro Equipment of Canada, Ltd., Toronto 15, Ontario.

Offices in All Principal Cities



ARO®
SPEED COUPLERS
Also Air Tools... Air Hoists... Lubricating Equipment . . . Aircraft Products . . . Grease Fittings

LETTERS to the editor

enough to fit into your very limited space requirements. It may also be possible to adapt one of several small packages built for agricultural and construction equipment. We've sent a list of possible sources.

Wants a Book on Troubleshooting

I will appreciate your assistance in finding a good book on "How to Locate the Trouble and Make Repairs on Hydraulic Equipment". This book should be written for the average good mechanic out in the plant.

PETER DEVIT
Botwinik Brothers
New Haven, Conn.

There is no complete simple source that can be a short cut to training the shop mechanic in the care of hydraulic equipment. We have sent you a copy of our Data List which gives you a brief summary of available literature in the field.

"It's Not New At All"

I want to call your attention to Mr. Fawcett's article in the June issue to which you refer on the Fluid Power Lines page as "relatively new". The same scheme is described in my book "Oil Hydraulic Power" on page 240, figure 190. This book was originally published in 1949.

WALTER ERNST
Dayton, Ohio

We almost always get into trouble when we use the phrase "relatively new". Someone is sure to write that the "relatively new" idea was used back in 1862. Actually, the circuit described by Mr. Fawcett is not widely known or applied. Although the basic principles of flow control circuits have been presented before, there is still much that can be done toward obtaining wider applicaton. Readers who are not familiar with Mr. Ernst's book will find it a valuable addition to their library. ▼▼▼

Keelavite

Solenoid-operated

PILOT VALVES

NEAT • ROBUST • COMPACT

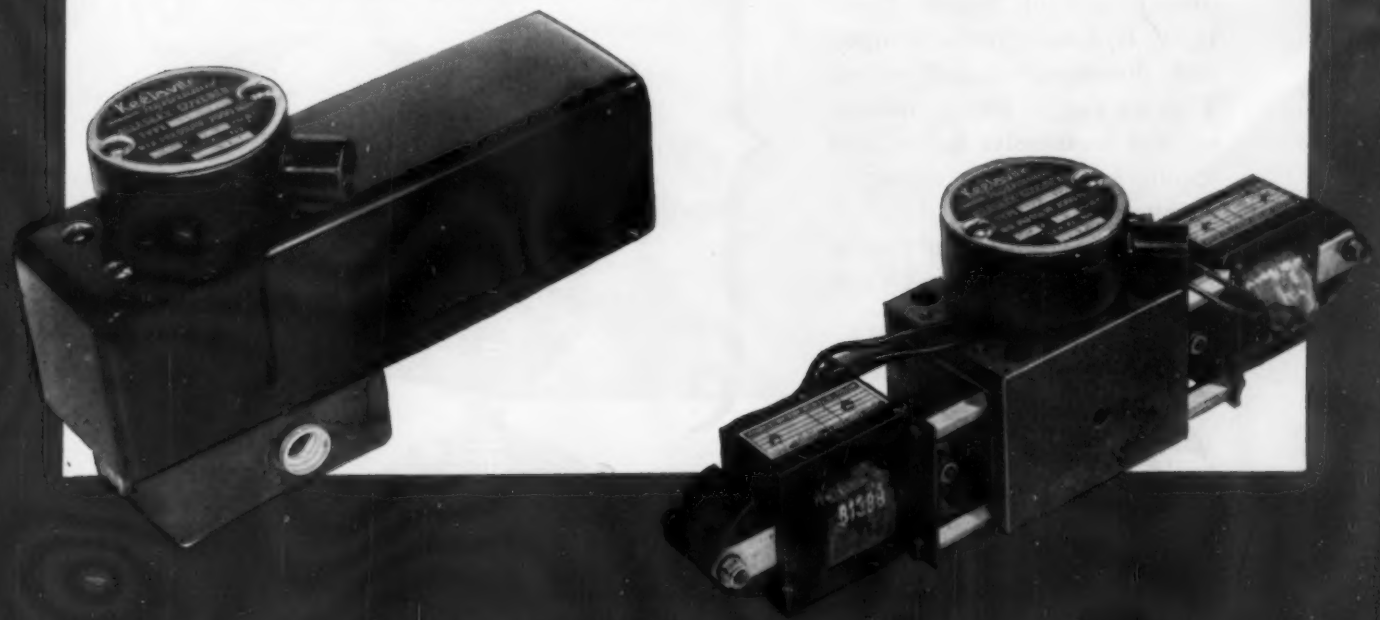
This new series of solenoid-operated pilot valves is a notable addition to the existing Keelavite range of sequence and interlock control gear. Its field of application in automatic hydraulic machinery is extremely comprehensive by virtue of the numerous alternative standard assemblies. Identical units may be used for electrically controlled piloting duties or small flow direction control. A further range can be mounted directly on to current Keelavite 3/4", 1", 1 1/2" and 2" directional valves to form a composite pilot-operated direction control unit. A gasket mounting type is available for attachment to other equipment.

HYDRAULIC DATA

Working pressure 2,000 p.s.i. • Rated Flow 1 1/2 g.p.m. • 1/4" B.S.P. ports • Internal and external pressure and exhaust connections • Choice of several standard pistons • Send for data sheet giving installation dimensions.

ELECTRIC DATA

Continuously rated solenoid • Single or double acting • 110-440 volt, single phase A.C. supply • Initial Load 350 v.a. • Closed load 60 v.a. • Terminal box rotatable through 360° • Solenoids housed in stove enamelled covers.



KEELAVITE ROTARY PUMPS & MOTORS LTD.
ALLESLEY, COVENTRY, ENGLAND
Telephone: Meriden 2254

THE RECOGNISED AUTHORITY ON HYDRAULIC POWER TRANSMISSION

ALL Pathon Hydraulic Cylinders Series RH 2000 P.S.I. or QH 1000 P.S.I. are designed to provide maximum strength and fatigue life in a minimum of mounting space. The use of a single screw thread to attach the head to the body of the cylinder assures smallness in physical size and at the same time gives low stress concentration throughout the barrel to head attaching area with a resultant *plus factor* for shock loading. *Your* Pathon Hydraulic Cylinders are more compact, stronger and yet require less maintenance.

Pathon
HYDRAULIC CYLINDERS

You get
EXTREME COMPACTNESS
EXCEPTIONAL PERFORMANCE

A MAXIMUM of operational efficiency in minimum space is characteristic of Pathon Series H4W Hydraulic remotely operated directional control valves. They are easy to install, convenient and inexpensive to use, and require an absolute minimum of maintenance attention.

Write us today for your Pathon Oil Hydraulic Cylinder and Valve Bulletin No. 22.

Pathon
HYDRAULIC VALVES

Pathon MANUFACTURING CO.

3823 Pacific Avenue Cincinnati 12, Ohio

Circle 71 on Reader Service Card

Circle 84 on Reader Service Card →

Fiatt, Illinois Mine uses

STANOIL

Industrial Oil in stripper hydraulic jacks for 18 years

At Truax-Traer Coal Company's Fiatt, Illinois, mine, the production goal is 1,000 tons of coal an hour. That's a stiff assignment. It leaves no margin for failure. This indeed applies to the hydraulic jacks of the company's Bucyrus-Erie 950-B stripper. It's the reason STANOIL Industrial Oil has been used as the hydraulic fluid in the four hydraulic jacks since the stripper went into operation in 1937. Eighteen years continuous service is testimony to STANOIL's ability to deliver under any operating condition—heat, cold, rain, dust, dirt.

But there's more to the story than just the ability of STANOIL Industrial Oil to deliver under a wide range of operating conditions. The rest of the story is the Standard technical service provided by men with training and experience.

This combination — (1) top quality products (2) technical service provided by experienced men — is ready to serve you. Want this combination to go to work for you? In the midwest just call your nearby Standard Oil lubrication specialist. Or contact: Standard Oil Company, 910 South Michigan Avenue, Chicago 80, Illinois.

Since start of operations in 1937, STANOIL Industrial Oil has been used as hydraulic fluid in Bucyrus-Erie stripper at Truax-Traer Coal Company mine, Fiatt, Illinois. This 950-B stripper is hub of one of the biggest strip mining operations in Fulton County, state's second largest coal producing county.

Bob Wright, Standard Oil lubrication specialist is on the spot to provide technical service on lubrication problems. Bob has a B.S. in engineering from Michigan College of Mining. Before entering field sales work, Bob completed Standard's Sales Engineering School course in industrial lubrication. Customers find this experience and background pay off for them.

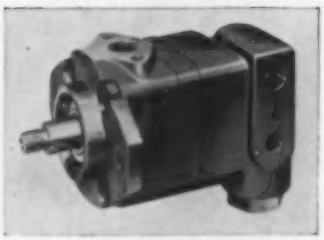
STANDARD

STANDARD OIL COMPANY

(Indiana)

New Products

Components, tools and equipment for fluid power systems. For more information fill in and mail post card bound in this issue.



HYDRAULIC PUMP
. . . for hydraulic starters

Designation: Series VU-100.

Application: Pump is used in an accumulator system which provides power for cold starting of gasoline or diesel engines in stationary, marine, or large mobile equipment such as construction, agricultural, and road building machinery. Accumulator is maintained between 2100 and 2500 psi.

Design: Pump includes an integral unloading valve for compactness and system simplification. Unit is suitable for pressures up to 2500 psi and speeds up to 3600 rpm. Pump capacity is 1.5 gpm at 2000 rpm and 2000 psi. It can be driven directly or through a gear drive. Cover design permits installation in a variety of positions.

Vickers Incorporated
Detroit, Michigan

Circle 110 on Reader Service Card

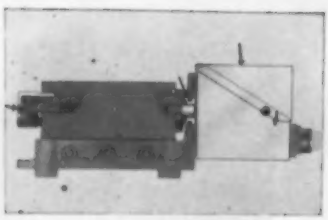
RUBBER-TO-METAL BONDING
. . . new precision process

Designation: Permadizing

Features: With the process rubber-to-metal bonded parts are entirely free of harmful flash and flaring of rubber and bonding agent on metal inserts. The resulting parts have dimensional tolerances held as close as on metal—as fine as five micro-finish. The process has successfully bonded aluminum to many varying compounds of rubber, synthetic rubber or silicone. It is a high-production process, giving consistent, variation-free results even over the longest production runs. Permadized parts exhibit extremely low swell, are highly resistant to hydraulic fluids, and can be made corrosion-resistant. Process is of special interest to aircraft engineers and aircraft valve designers concerned with extreme operating ranges of temperatures and pressures.

Stillman Rubber Co.
Culver City, California

Circle 111 on Reader Service Card



SOLENOID VALVE
. . . protected against dirt

Designation: "O"-Type

Design: Sintered bronze filter is provided in the breather hole of the spring cap. This filter consisting of small bronze particles pressed together into a porous mass permits air to pass through the filter in either direction but prevents the entrance of dust or grit which might interfere with the return spring or work into the internal valve parts. A sleeve sealed with O-rings at two places prevents foreign materials from entering the area where the solenoid armature contacts the valve plunger. Solenoid cover fits tightly protecting the solenoid. Ample space permits easy wiring of the solenoid and adequate room for connections.

C. B. Hunt & Son, Inc.
Salem, Ohio

Circle 112 on Reader Service Card

Continued on page 33

NOW!

OVER 600

Original Equipment Manufacturers install

MARVEL Synclinal FILTERS

as Standard Equipment!

SUMP TYPE
(Cutaway)

This figure represents manufacturers of all types of production equipment and components of equipment utilizing hydraulic and other low pressure circulating systems.
We are extremely proud of this impressive figure as a whole, and we take great pride in the fact that it still includes those who selected MARVEL SYNCLINAL FILTERS as standard equipment in our first year of operation over 12 years ago.

AND—the number increases steadily—Week by Week!

For Dependable Protection on all Hydraulic and Other Low Pressure Circulating Systems, and For Efficient Filtration of Hydraulic Oils, Fire-resistant Fluids, Coolants, Lubricants and Water—

Investigate
MARVEL SYNCLINAL FILTERS
They Meet J. I. C. Standards

A SIZE FOR EVERY NEED

Available for sump or line installation in capacities from 5 to 100 G. P. M. Greater capacities may be attained by multiple installation (as described in catalog). Choice of monel mesh sizes range from coarse 30 to fine 200.

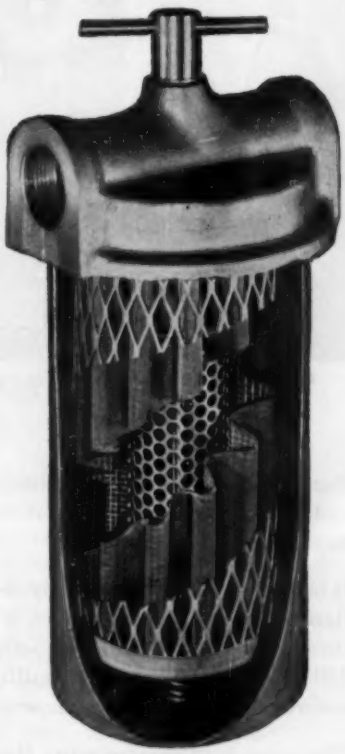
EASY MAINTENANCE

Both sump and line types may be easily disassembled, thoroughly cleaned and reassembled by any workman, on the spot, in a matter of minutes. Line type operates in any position and may be serviced without disturbing pipe connections.

IMMEDIATE DELIVERY

As in the past, Marvel continues to offer Immediate Delivery!

See Our Exhibit — Booth #809
at the
PRODUCTION ENGINEERING SHOW
Navy Pier — Chicago, Ill. — SEPT. 6 to 16.
See MARVEL SYNCLINAL FILTERS in Action!
See WHY — Over 600
Original Equipment Manufacturers
install them as
STANDARD EQUIPMENT!



LINE TYPE
(Cutaway)

Catalogs containing complete data available on request

MARVEL ENGINEERING COMPANY

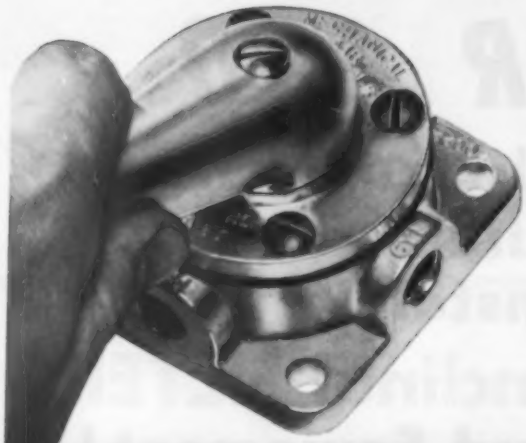
625 W. Jackson Blvd., Chicago 6, Ill., Phones: FRanklin 2-3530 & FRanklin 2-4431

Without obligation, please send me complete data on Marvel Synclinal Filters, as indicated AH-8
☐ Catalog #106—For Hydraulic Oils, Coolants and Lubricants
☐ Catalog #300—For WATER
☐ Data on filters for fire-resistant hydraulic fluids.

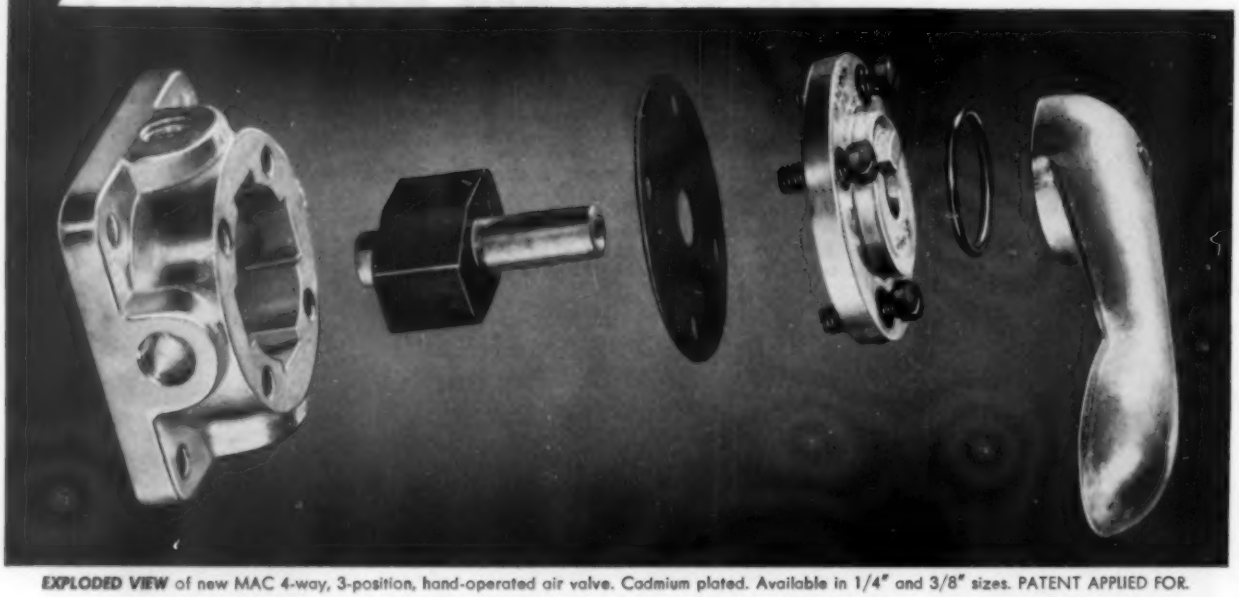
Name _____ Address _____

Title _____ City _____

Company _____ State _____



ANNOUNCING—
a new rotary air valve that's maintenance-free



EXPLODED VIEW of new MAC 4-way, 3-position, hand-operated air valve. Cadmium plated. Available in 1/4" and 3/8" sizes. PATENT APPLIED FOR.

Here is an entirely new, simplified hand valve—designed and backed by MAC to outperform and outlast virtually any air valve in the industry.

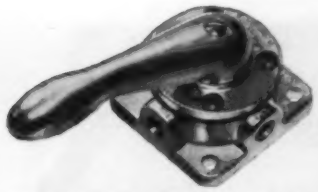
It is one of the few specifically designed for hand operation. A rotary 3-position type, it permits easy, variable throttling . . . operates smoothly at pressures up to 150 psi . . . will operate millions of cycles without maintenance or measurable wear.

The rotor is of long-wearing Hy-Car rubber bonded to the shaft. Unlike other valves where the holes pass over the ports, the MAC rotor passes only over smooth, rounded surfaces — guaranteeing a superior seal and longer valve life. There's no metal-to-metal contact. No scoring of surfaces. No danger from dust or dirt, either, owing to a special "O" ring seal under the valve's handle.

Check into this new MAC valve now. And ask about our complete line of modern, low-cost valves, too. Telephone your MAC representative listed at the right, or write us direct for free literature.

MECHANICAL AIR CONTROLS, INC.
10030 Capital, Oak Park, Detroit 37, Michigan

MAC



PHONE YOUR NEARBY "MAC" REPRESENTATIVE FOR DATA AND DELIVERY

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SOUTH GATE—The Rucker Co., 4956 Firestone Blvd., KImball 8271

ILLINOIS
CHICAGO 43—Mike C. Modrich & Co., 10336 South Western Ave., Hilltop 5-3640

INDIANA
FORT WAYNE 3—Neff Engineering Co., P. O. Box 2001, Station A, 2339 Crescent Ave., EAstbrook 7391
INDIANAPOLIS 20—Neff Engineering Co., P.O. Box 7361, 42nd St. Station, BRoadway 2330
SOUTH BEND—Dick Futter, 103 South Varsity Dr., 2-4856

MARYLAND
BALTIMORE 6—Grand Air-Hydro Division, K. William Ostrom & Co., Inc., 6105 Alta Ave., HAmilton 6-6669

MASSACHUSETTS
BOSTON 34—Electrical Apparatus Co., Inc., 1200 Soldiers Field Rd., STadium 2-7440

MICHIGAN
BAY CITY—Fred Kober, 506 Chilson St., 2-2629
FLINT—Kober Sales Engineering Co., 514 Beach St., CEdar 8-5123
GRAND RAPIDS—Kober Sales Engineering Co., 190 Monroe Ave., GLendale 4-3252

MINNESOTA
MINNEAPOLIS 4—Air Engineering & Supply Co., 2445 Nicollet Ave., FIlmore 5579
ST. PAUL 14—W. H. Schultz Co., 2438 Franklin Ave., Midway 2744

MISSOURI
ST. LOUIS COUNTY—Oscar E. Jost Co., P. O. Box 162, St. Ann, HArrison 8-4488

NEW YORK
BUFFALO 21—C. H. Tepas Co., 200 Washington Hwy., Circle 3210

OHIO
CINCINNATI—The R. W. Nichols Co., Fidelity Federal Savings Bldg., 2087-9 Sherman Ave., Norwood, ELmhurst 2440
DAYTON—The R. W. Nichols Co., 407 Realty Bldg., Michigan 4724
OLMSTED FALLS—The R. W. Nichols Co., P. O. Box 6, BErea 4-1379
TOLEDO 4—The R. W. Nichols Co., 510 Manhattan Bldg., MAin 8623
YOUNGSTOWN 3—The R. W. Nichols Co., 202 Schwenn-Wagner Bldg., Riverside 4-4550

OREGON
PORTLAND—The Rucker Co., 911 N. W. Hoyt St., BEacon 0205

PENNSYLVANIA
PHILADELPHIA 4—Grand Air Hydro Div., K. Wm. Ostrom & Co., Inc., 3717 Filbert St., EVergreen 2-5444
PITTSBURGH 22—The R. W. Nichols Co., 101 Investment Bldg., ATlantic 1-6050

TEXAS
DALLAS 19—Womack Machine Supply Co., 6409 Maple Ave., DIxon 6997

WASHINGTON
SEATTLE—The Rucker Co., Whyte-Henry-Stuart Bldg., Rm. 203, MAin 2783

WISCONSIN
MILWAUKEE 10—Neff Engineering Co., 2837 North 50th St., Hilltop 5-3340

CANADA
ONTARIO, HAMILTON—Higginson Engineering Sales, P. O. Box 23 (275 James, North), JAckson 9-2262

MECHANICAL AIR CONTROLS, INC.
DETROIT 37, MICHIGAN

MAC

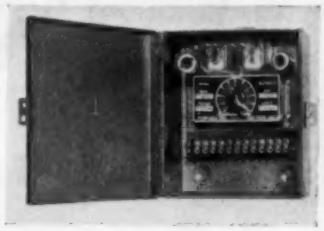
Post Scripts of Industry

continued

ELECTRONIC TIMER
. . . . for local or remote adjustment

Designation: T-1

Features: Timer permits multiple modes of operation including interval, delayed action, repeat cycle, and single cycle timing. Unit can be supplied with standard time ranges



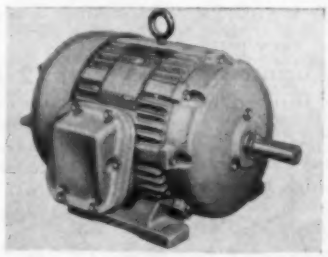
of .3-25 or .5-50 seconds. The 270-degree calibrated dial assembly can be removed for remote operation.

Design: No standby power is required and cold cathode tubes eliminate warm-up time. Unit has 5-ampere isolated load contacts and plug-in relays. Available in open construction NEMA 1A (semi-dust tight) and NEMA XII (oil tight) enclosures.

Ferrara Inc.
Oak Park, Michigan
Circle 113 on Reader Service Card

EXPLOSION-PROOF MOTORS
. . . for most hazardous locations

Application: Underwriters Laboratory approval permits use of these



motors for all Class I Group D and Class II Groups E, F and G hazardous locations. This simplifies stocking problems for manufacturers who sell to industries requiring various explosion-proof protection.

Specifications: Motors are available in ratings of 1 to 25 hp, three phase; and 1 to 3 hp, single phase. Modifications of three-phase motors are also available with Underwriters approval for use in Class I Group C hazardous locations.

Louis Allis Co.
Milwaukee, Wisconsin
Circle 114 on Reader Service Card

FITTINGS AND HOSE KITS
. . . for plant maintenance

Designation: No. 5143 and No. 5144

Features: Kits are made of steel to replace former cardboard kits

and contain removable compartment tray, handy attached ruler, and fitting identification chart. Kit No. 5143 contains 71¼-inch fittings and 24 ft. of ¼-inch hoseline on a revolving reel. Kit No. 5144 contains an assortment of 93 fittings, including both ¼-inch and ⅜-inch sizes and types and two spools holding 24 feet of ¼-inch and ⅜-inch hose. Hose and fittings are rated at 250 psi and burst pressure is over 1000 psi.

Aeroquip Corp.
Jackson, Michigan
Circle 115 on Reader Service Card

For more NEW PRODUCT reviews turn to page 80

Flexibility IN Design

helps make

WEBSTER

YOUR BEST BUY

in Gear-Type Hydraulic Pumps

The WEBSTER engineer is not limited in selecting the proper hydraulic pump or fluid motor for your application. He can choose from over 100 different models ranging in capacities from 1/5 to 30 GPM, for pressures up to 1500 psi, speeds to 3600 RPM.

Moderately priced, the complete WEBSTER line features designs notable for compactness and adaptability. Standardization and interchangeability of parts makes it possible for WEBSTER to increase or decrease capacity and vary porting without changing the mounting or necessitating adaptor plates. Reliability is insured by quality construction features such as:

- Heavy-duty needle bearings withstand overloads. Anti-friction bearings throughout assure high mechanical efficiency.
- Temperature and oil resistant synthetic lip seal.
- Smooth running helical gears of alloy steel are precision made and properly hardened for quiet operation, long life.
- Double-row ball bearings absorb compound driving thrusts.
- Standard external seal drain permits use in either rotation. Internal drain can be furnished if desired.
- Pump cover is available with either end or side ports.
- Standard two-bolt S.A.E. magneto mount. Other mountings available.

***FREE 12-PAGE CATALOG** contains complete information on WEBSTER'S complete line of over 100 different positive displacement gear-type pumps and fluid motors. Write for your free copy today.....*

OIL HYDRAULICS DIVISION

WEBSTER ELECTRIC

RACINE WISCONSIN

MANUFACTURERS OF A COMPLETE LINE OF OIL HYDRAULIC PUMPS FROM 1/5 TO 30 GPM CAPACITY

Designing for more customer satisfaction?

J-M Moulded Packing Cups, installed on air cylinder piston of Morgan Laundry press, provide tighter, more efficient seal and eliminate troublesome maintenance problems

When Morgan Laundry changed to J-M Moulded Packing Cups, they found

"Maintenance on packings practically eliminated . . ."

The Morgan Laundry, large supplier to hotels and institutions, encountered excessive down time for maintenance of their laundry presses. Packings supplied as original equipment on the air cylinder pistons of the presses needed frequent lubrication to prevent drying out. It was difficult to maintain proper cleanliness of the equipment.

When the company replaced the conventional material with J-M Moulded Packing Cups, packing life was increased. These packings required practically no maintenance, and the danger of soiling laundry because of relubricating packings was completely eliminated.

Designers and manufacturers can offer their customers many advantages by providing J-M Moulded Packing Cups on original equipment. These custom-made materials may be used on practically all types of air- or hydraulic-operated cylinders. They help improve operating efficiency, and they make possible easier, cleaner maintenance. These factors are especially important in critical installations such as hospitals and hotels, as well as laundries and other service establishments.

J-M Moulded Packing Cups are available in a variety of compositions to meet a wide range of pressures, temperatures and service conditions. For more information on all types of Johns-Manville Moulded Packing Cups, write to Johns-Manville, Box 60, New York 16, N. Y. In Canada, 199 Bay Street, Toronto 1, Ontario.

Johns-Manville PACKINGS & GASKETS

Useful Literature

For your free copy of publications reviewed, fill in the reader service card

CYLINDERS . . . for 200 psi air or 500 psi oil or water service are the subject of Bulletin IC-2.3 released by National Pneumatic Co., Inc. The cylinders have adjustable cushions at either or both ends for specific speeds and prevention of damage. The bulletin illustrates the method of attaching the end caps with a lock ring assembly so that the end caps can be rotated for proper pipe orientation. A sectional view shows constructional features of the cylinders such as piston cups which automatically compensate for wear and seamless steel rustproof cylinder body. Cylinder data, mounting dimensions, and drawings of various mountings—pivot, clevis, foot, trunnion, flange—are included.

Circle 165 on Reader Service Card

AIR VALVES . . . Four-way, two-position valves with interchangeable actuators for hand, cam, or solenoid operation are described in Bulletin 309 A published by Ross Operating Valve Co. The heads and internal parts of these valves may be changed without disturbing piping. They are equipped with ⅛-inch NPT ports and can be used as a 2-way or 3-way valve by plugging ports.

Circle 166 on Reader Service Card

SELF-FLARING FITTINGS . . . which reduce installation time are described in Catalog BA 555 published by Flodar Corp. The catalog illustrates installation features of the fittings and points out advantages. A chart for proper selection of fittings for particular tubing is also included. The fitting design features burnished sealing surfaces, and will hold pressures in the order of 20,000 psi or more with adequate tubing. Because the unit cannot be assembled unless the fluid will have an unrestricted passage free from collapsed walls or burrs, free flow is assured. Cut-away drawings showing progressive stages in the installation are shown to illustrate the performance.

Circle 167 on Reader Service Card

HYDRAULIC TRANSMISSIONS . . . consisting of a pump and motor are specified in a pamphlet from Vickers-Armstrongs Ltd. The variable delivery pump and the motor are axial piston units. The motor is normally rated to transmit constant horsepower over the upper half of the speed range with a constant torque equivalent to twice the full-speed running torque below half speed. Horsepower ratings for the motors range from 2.5 to 150 with starting torques from 42 to 6000 lb-ft. Pumps are available for maximum deliveries from 5.5 to 360 gpm. Various types of speed controls are applicable to the variable delivery pump including manual-mechanical control, hydraulic servo ram control, and pushbutton control. With hydraulic control, a standard lever is actuated by a hydraulic servo ram which amplifies the input.

Circle 168 on Reader Service Card

FLOW SENSER . . . Hays Manufacturing Co. has issued Folder No. 260 to cover their automatic interlock called "Shur-flo". The unit is a protective device for use in air lines, water lines, or light oil lines to ensure a fixed flow. The device operates on a differential pressure across a nozzle and the flow setting can be changed by changing the nozzle orifice. The pressure differential is sensed by a diaphragm which transfers motion to a limit switch which controls an external electrical circuit. The catalog includes a chart showing average pressure drop of water on open discharge from 0 to 150 psi. The interlocks are available for protection against insufficient or excessive flow from 1/10 to 40 gpm.

Circle 169 on Reader Service Card

VARIABLE DELIVERY PUMPS . . . products of Dudco Div. The New York Air Brake Co. are presented in Bulletin DP350 now available. The high pressure pumps are designed for hydraulic systems requiring constant pressure with control of fluid delivery from zero to full flow. Continuous duty pressure rating is up to 5000 psi with a delivery of 4 gpm at a maximum speed of 2000 rpm. The bulletin illustrates the PVM model with handwheel control for manual adjustment of output, and the PVC model with pressure-compensated control for automatic regulation of pressure and flow. A cut-away view shows construction details of the axial piston design, and performance curves of both models indicate delivery and horse-power input over the range of pressures.

Circle 170 on Reader Service Card

For more reviews of FREE LITERATURE turn to page 97

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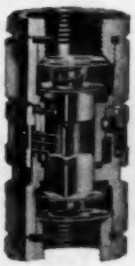

Available with valves to give two-way or one-way automatic line shut-off, or without valves for straight-thru flow, "H" Couplings are built to handle high pressures in hydraulic and air systems.

Recessed valve washers . . . fluted valve stems . . . valve stops with minimum flow restrictions . . . large inside diameter—allow maximum flow capacity with lowest pressure drop.

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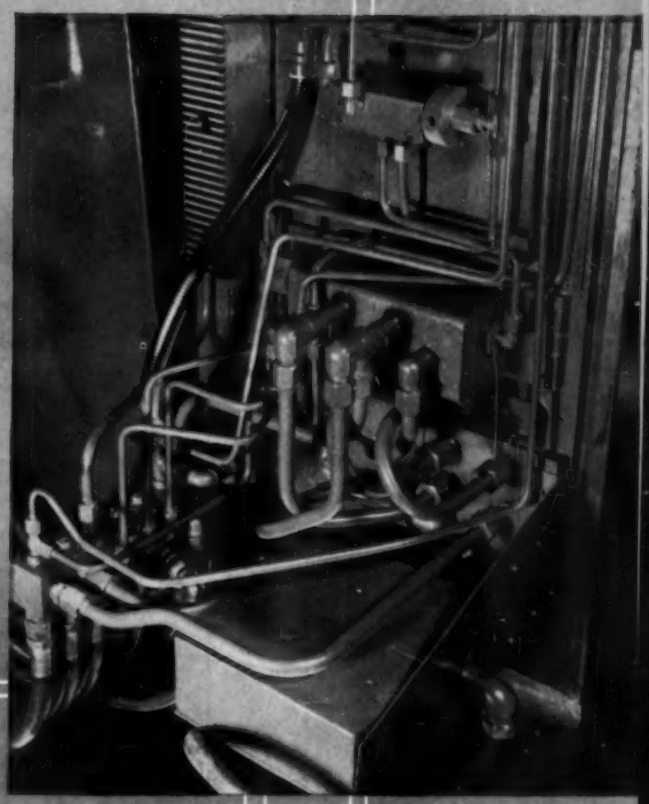
To obtain good efficiency from your fluid power system, no step in the design is more important than the selection of fluid line size. Two methods of selection are shown here. The first, based on the rule of thumb of 10-15 fpm maximum velocity, can easily result in poor design if it is not carefully applied. The second method which bases the selection on flow characteristics will assure high system efficiency by reducing losses caused by heat.



How to Select FLUID LINE SIZES *for Oil Hydraulic Systems*

• By Allan E. Morris
Associate Editor

IN specifying pipe, tubing, and flexible hose, the hydraulic design engineer must determine the inside diameter and the wall thickness. The diameter of the fluid line is a function of permissible pressure drop and the rate of fluid flow. Fluid flow rate in gpm is determined by the required velocity and size of the cylinders or fluid motors. Wall thickness of the lines depends on the system pressure.

For a cylinder, the fluid rate is calculated from the formula:

$$GPM = \frac{60\,A\,D}{231\,T} \quad \text{.....(1)}$$

Where A=Piston area (sq. in.)
D=Stroke distance (in.)
T=Time of stroke (seconds)

For a fluid motor, the fluid flow rate is calculated from the formula:

$$GPM = \frac{d\,(RPM)}{231} \quad \text{.....(2)}$$

Where d=Displacement (cu. in. per rev.)

For example consider a cylinder with a 6-inch bore and a 2-inch piston rod. The cylinder is required to extend 5 inches in 2 seconds and retract in 1 second. Using formula (1):

Extend:

$$GPM = \frac{28.2 \times 5 \times 60}{231 \times 2} = 18.4$$

Retract:

$$GPM = \frac{(28.2 - 3.1) \times 5 \times 60}{231 \times 1} = 33.9$$

Table I presents a convenient listing of oil displacement per inch of stroke for cylinders of various sizes.

In selecting line size, a common practice is to follow the rule that fluid velocity should not exceed 10 to 15 fps depending on the duty cycle of the system. This rule can not be used indiscriminately for all fluids. Best results are with systems using a 225 SSU @ 120°F hydraulic oil.

Experience has shown that for these systems, this rate of flow does not cause excessive heating or pressure drop.

SHOCK LOADING

Another reason this figure has been adopted as a maximum is because of the shock loading at higher rates of flow. Calculations show that when a valve is closed, an additional pressure of 60 psi is created for each fps of fluid velocity. Thus, closing

TABLE I

Cylinder Bore in Inches	Piston Area Sq. In.	Gallons Displaced Per Inch of forward Stroke	Piston Rod Diameter In Inches	Piston Rod Area Sq. In.	Gallons Displaced Per Inch of return Stroke
1½	1.767	.00765	⅝	.307	.00133
2	3.142	.01360	1	.785	.0034
2½	4.909	.0213	1⅜	1.485	.00673
3¼	8.296	.0359	1¾	2.405	.01041
4	12.566	.0544	2	3.142	.01360
5	19.635	.0850	2½	4.900	.0213
6	28.274	.1224	3	7.069	.0306
7	38.485	.1666	3½	9.621	.0417
8	50.265	.2176	4	12.566	.0544
10	78.54	.3400	4½	15.904	.0688
12	113.10	.4896	5	19.635	.0850
14	153.94	.6664	5½	23.758	.1028

TABLE I Oil displacement per inch of stroke for various cylinders.

TABLE II

I.D.	Standard Weight Pipe Size	Recommended velocity-feet per second Max.	GPM Flow
.493	⅜	7	4.2
.622	½	10	9.5
.824	¾	12½	21.
1.049	1	15	40.
1.380	1¼	15	70.
1.610	1½	15	95.
2.067	2	15	157.
2.469	2½	15	224.

TABLE II Line selection chart for systems using a 225 SSU @ 120° F oil.

a valve with a fluid velocity of 15 fps creates a shock loading of 900 psi. If only this shock loading is considered, velocities higher than 15 fps might be used if the shock capacity of the fluid line components is not exceeded. JIC Standards state that the operation of a valve shall not produce detrimental surges in the hydraulic system. In addition, the standards state that lines shall have adequate strength to withstand additional pressure, including surge pressure, within the safety limits of the entire circuit. A factor of safety of at least 8 over normal working pressure is suggested. Table II is based on these rules. In pipe sizes under 1 inch the recommended velocity is less than 15 fps because of the increased pressure drops and frictional heat created at higher velocities. In suction lines, a maximum fluid velocity of 5 fps is recommended to prevent pump cavitation.

From Table II it is determined that 1-inch cylinder ports and piping should be used in the example above. It should be noted that while ¾-inch fluid lines would be sufficient to carry fluid to the head end during extend stroke, this same line must carry the drain fluid on retract stroke, so that it must be the same size as the line to the rod-end port. When extra-heavy pipe is used, the pipe sizes shown in Table II should be increased one size and when double extra heavy pipe is used, the pipe sizes should be increased two sizes. By using the ID column of Table II the required steel tubing or flexible tubing can be selected. Table II can only be applied to systems using a hydraulic oil having a viscosity of 225 SSU at 120°F.

DETERMINING FLOW CHARACTERISTICS

Use of an arbitrary maximum flow velocity often results in line sizes which are too small. For a more accurate determination, the flow characteristics of the fluid should be calculated.

Fluid friction is caused by the movement of molecules with respect to each other. This tendency for the molecules to move is called viscosity. Friction in a line is analagous to resistance in an electrical circuit, and the resulting pressure drop and heating is similar to voltage drop and power loss in a wire. For fluid line selection it is important to know whether flow is laminar or turbulent. Flow is laminar when it is in lines parallel to the pipe. Flow is turbulent when the fluid particles intermingle.

The range in which flow changes from laminar to turbulent is indicated by the Reynolds number which is calculated from the formula:

$$R = \frac{V\,d\,\rho}{\mu} \qquad (3)$$

Where V = Average fluid velocity (fps)
d = line ID (feet)
ρ = Fluid density (lb per cu. ft.)
μ = Fluid viscosity (lb per sec-ft.)

To convert viscosity in SSU to lb/ft-sec for use in formula (3), first determine viscosity in centipoise from the formula:

$$\mu' = S\left(.22\ SSU - \frac{135}{SSU}\right)$$

Where SSU = Viscosity (Seconds Saybolt Universal)
S = Specific Gravity
μ' = Viscosity (centipoise)
Then, since 1 centipoise = .0000209 slug/ft-sec
and 1 slug = 32.2 lb
To express μ' in lb/ft-sec multiply formula (4) by .0000209 and 32.2 to obtain:

$$\mu = .000672\ S\left(.22\ SSU - \frac{135}{SSU}\right) \qquad (4)$$

Where μ = Viscosity (lb/ft-sec)

Formula (3) shows that the pipe dimensions and properties of the fluid determine whether the flow will be laminar or turbulent. It has been found

that for Reynolds numbers from 2000 to 4000, the flow changes from laminar to turbulent. For optimum heat dissipation and laminar flow, the Reynolds number should not exceed 2000.

LINE SELECTION GRAPHS

The graph of Figure 1 has been developed for selecting tube sizes based on Reynolds number. Rate of fluid flow vs. fluid velocity has been plotted for various tube sizes. Points on the straight lines were calculated from the formula:

$$V = \frac{.32\,Q}{A} \qquad (5)$$

Where Q = Flow rate (gpm)
A = Area of fluid line (sq. in.)
V = Velocity (fps)

For example the velocity in a 1-inch tube of .065-inch wall thickness with 20 gpm flow is:

$$V = \frac{.32 \times 20}{.595} = 10.8 \text{ fps}$$

In Figure 1 the 20 gpm line intersects the 1-inch tube line at 10.8 fps.

The dashed hyperbolic lines were plotted by solving for velocity in formula (3) using a Reynolds number of 2000. Points were determined for each tube using the density and viscosity of the oil at 115°F. Two types of oil having viscosities of 111 SSU and 203 SSU at 115°F were plotted.

For example with "150" oil having a density of 53.2 lb per cu. ft., 1¼-inch tubing of .095-inch wall thickness, and fluid of 111 SSU viscosity:

$$V = \frac{R\,\mu}{d\,\rho} = \frac{2000 \times .0138}{.0883 \times 53.2} = 5.87 \text{ fps}$$

Velocities to the left of the dashed lines will insure laminar flow. Velocities to the right of the dashed lines will cause turbulent flow.

For example, it is required to pump 24 gpm of "150" oil. Tracing over on the 24 gpm line to the 2-inch tubing, puts us well within the laminar area left of the dashed line with a velocity of 3.2 fps. Going to 1½-inch tubing puts us in the turbulent area, even though the velocity is only 5.8 fps. If "300" oil were used, we would follow the 24 gpm line to the 1-inch tubing line which is just within the laminar flow region with a velocity of 13 fps. If it were required to pump 20 gpm of "150" oil, it would be permissible to use 1½-inch tubing, if the oil were maintained at a temperature lower than 115°F. This would raise the viscosity number and move the dashed line to the right. Figure 2 shows vicosities of fluids "150" and "300" as a function of temperature.

Similar graphs can be plotted for any range of tubing, pipe, or flexible hose if the ID of the line and the viscosity and density of the fluid are known.

When fluid flows in a pipe, the velocity is greatest

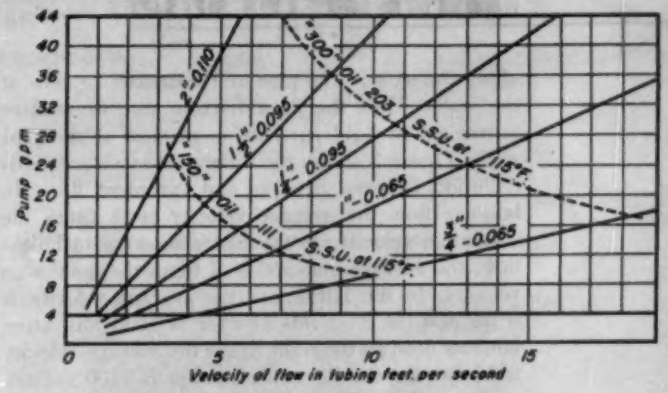


FIG. 1. HYPERBOLIC curves plot the limiting velocities and oil flows for two different oils. The curves are based on a Reynolds number of 2000. To minimize pressure drop and heat generation, fluid line size should be selected so that flow will be laminar. All points to the left of a hyperbolic curve will give laminar flow when using the noted oil at the given temperature.

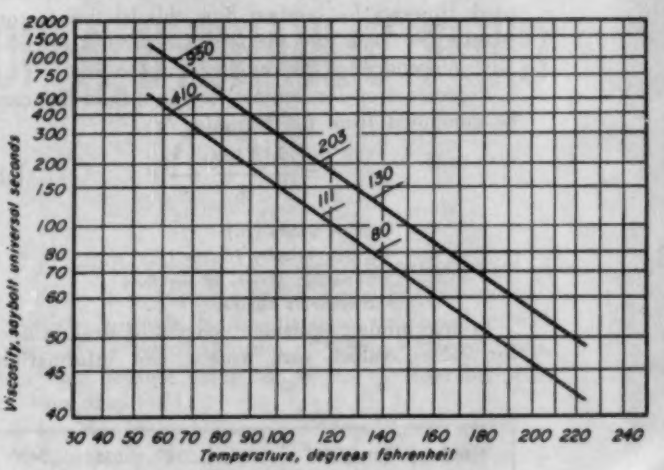


FIG. 2. VISCOSITIES of fluids plotted against temperature simplify the calculation of Reynolds number. Two petroleum base fluids, a 150 SSU at 100°F and a 300 SSU at 100°F are shown.

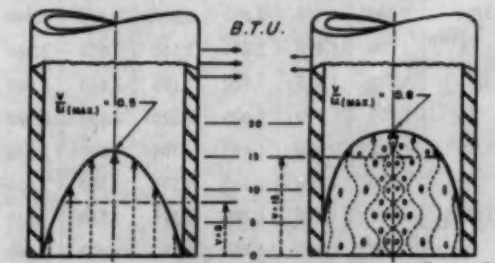

B.T.U.
This comparative scaled evaluation is for 3/4"-0.065" steel tubing with "150" hydraulic oil flow at 115°F.
1655 R 3100
8 ft./sec. v 15 ft./sec.
15 ft./sec. U(max.) 18.8 ft./sec.
7.5 G.P.M. 14.1

FIG. 3. COMPARISON of turbulent and laminar flow.

along the axis of the pipe and decreases to zero at the walls. Thus the fluid friction due to relative movement of fluid particles is greatest at the pipe walls. Figure 3 shows the difference in velocity distribution between laminar and turbulent flow. In laminar flow the average velocity is .5 times the maximum velocity. In the figure showing turbulent flow, the average velocity is .8 times the maximum velocity. In the left figure the average velocity is 8 fps and the Reynolds number is 1655 indicating laminar flow. In the right figure the average velocity is 15 fps, but the Reynolds number is 3100 indicating strong turbulence. With laminar flow, the pressure drop is proportional to the average velocity of the fluid particles.

Pressure drop in a fluid line can be computed from the fluid properties, the dimensions of the line, and the velocity of the fluid. If the flow is turbulent, an experimentally determined friction factor based on the roughness of the line must also be used. However for laminar flow, this friction factor is taken as 64/R and the pressure drop is essentially independent of the roughness of the line.

Pressure drop for laminar flow in a fluid line can be computed from the formula:

$$P = \frac{5.17\ L\ V^2\ S}{R} \qquad \text{.....(6)}$$

Where:

L = Line length (ft.)
V = Flow velocity (ft./sec.)
S = Specific gravity of the fluid
R = Reynolds number

In determining equivalent lengths of straight line for valves, values vary widely, and information should be obtained from the manufacturer. Equivalent lengths for fittings can be estimated by taking (a) 30 times the diameter of each elbow or right angle turn, (b) 5 to 20 times the diameter plus the length of long-radius turns, (c) 2 times the diameter of any change in area such as a reducer or drain outlet. As a typical example, compute the pressure drop in a fluid line having 50 ft. of .870 ID tubing, 3 valves with a total equivalent length of 10 ft. and other fittings with a total equivalent length of 10 ft. "300" oil with a viscosity of 203 SSU at 115°F and a specific gravity of .90 is used. Velocity of flow is 10 ft./sec.

Using formula (4), 203 SSU and .90 specific gravity is equivalent to .0266 lb/sec-ft.

From formula (3):

$$R = \frac{10 \times \left(\frac{.870}{12}\right) \times (.90 \times 62.4)}{.0266}$$

$$= 1530$$

Concluded on page 76

TABLE III

Pipe Size	OD	Schedule 80-1000 psi max: Wall Thickness	ID	Internal Area	Schedule 160-3000 psi max: Wall Thickness	ID	Internal Area
1/8	.405	.095	.215	.036	Use schedule 80		
1/4	.540	.119	.302	.072			
3/8	.675	.126	.423	.141			
1/2	0.840	0.417	0.546	0.234			
3/4	1.050	0.154	0.742	0.433			
1	1.315	0.179	0.957	0.719			
1 1/4	1.660	0.191	1.278	1.283	.382	.896	.630
1 1/2	1.900	0.200	1.500	1.767	.400	1.100	.950
2	2.375	0.218	1.939	2.953	.436	1.503	1.774

TABLE III Recommended pipe sizes for 1000 and 3000 psi systems.

TABLE IV

WALL OD	.020"	.025"	.028"	.032"	.035"	.042"	.049"	.058"	.065"	.072"	.083"	.095"	.109"	.125"
1/8"	4,800	6,000	6,700	7,680	8,430	9,920	11,750							
3/16"	3,200	4,000	4,470	5,100	5,610	6,750	7,850							
1/4"	2,400	2,980	3,350	3,830	4,200	5,040	5,890	7,000	7,850					
5/16"	2,000	2,410	2,690	3,080	3,370	4,040	4,710	5,610	6,290	6,950	8,010			
3/8"	1,600	1,990	2,240	2,560	2,800	3,360	3,920	4,660	5,240	5,790	6,660	7,640	8,720	9,990
7/16"	1,370	1,715	1,920	2,190	2,400	2,880	3,360	4,000	4,500	4,960	5,720	6,550	7,490	8,580
1/2"	1,200	1,490	1,675	1,920	2,100	2,520	2,940	3,500	3,925	4,340	5,000	5,720	6,540	7,500
9/16"	1,065	1,330	1,490	1,705	1,870	2,240	2,620	3,110	3,490	3,860	4,450	5,090	5,810	6,660
5/8"	1,000	1,200	1,340	1,535	1,680	2,020	2,350	2,800	3,140	3,470	4,000	4,580	5,230	6,000
11/16"	870	1,090	1,220	1,395	1,530	1,830	2,135	2,530	2,835	3,140	3,620	4,145	4,755	5,455
3/4"	800	1,000	1,120	1,280	1,400	1,640	1,960	2,320	2,600	2,880	3,320	3,800	4,360	5,000
7/8"	685	860	960	1,090	1,200	1,440	1,680	1,985	2,225	2,465	2,845	3,255	3,740	4,285
1"	600	750	840	960	1,050	1,260	1,470	1,740	1,950	2,160	2,490	2,850	3,270	3,750
1 1/8"	530	665	745	850	935	1,120	1,310	1,545	1,735	1,920	2,215	2,535	2,910	3,330

TABLE IV Tubing wall thickness chart. Working pressures provide a factor of safety of 5.

Courtesy Superior Tube Co.

Can you reliably select hydraulic fluids by studying characteristic charts and curves? Such data is a good starting place, but the final selection depends on actual performance of equipment in your plant. Here's how one large user of fluids established a yardstick for measuring performance. You can make use of this performance evaluation method for selecting petroleum base or fire-resistant fluids.

HOW TO EVALUATE PERFORMANCE OF A HYDRAULIC FLUID

• By J. R. Hemeon

PUMP service life is an excellent gauge for comparing performance of different hydraulic fluids. Considerable experimentation and the development of a "Yardstick" formula for pump wear has been carried out at the Trenton Plant of Ternstedt Division of General Motors Corp. This project was undertaken because pump life varied considerably with the use of different fire-resistant fluids.

On the machines used in the Trenton Plant, vane type pumps are used. Performance of a vane pump largely depends on the amount of pump ring wear. The tips of the vanes bear against this ring as pumping action takes place. A worn ring will greatly impair pump performance and will cause pulsations and noise. A ring seldom wears smoothly. Examination of a used pump ring will show transverse steps and ridges, primarily on the ring pressure sector surfaces.

Because this ring is the critical part, it is the best unit for measuring loss of weight due to wear. This loss of weight is a prime factor in the "Yardstick" formula. Comparison of pump rings after service, under controlled pressure and temperature conditions with different fluids will indicate performance of the fluid under test.

The formula has been set up to evaluate the milligram loss of pump ring weight, per thousand hours of operation, at 10,000 Btu/hr., with a controlled sump temperature of 120 degrees F.

Here is how the formula is applied. The pump ring is accurately weighed before and after the run to determine its loss of weight. It is then necessary to find the mean effective operating pressure (mep) and the duty load—Btu per hour—on the pump. Determination of the mep can be made from a pressure-time diagram of the machine cycle. On

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J. R. HEMEON, *Hydraulic Equipment Engineer, Ternstedt Div., General Motors Corp., Trenton, N. J.*

this diagram, pump pressure for every instant of the machine cycle is plotted against time to obtain a pressure curve. Integrating the area under the curve gives the mean effective pressure for the cycle.

To find the duty load on the pump:

$$\text{Btu per hour} = K \times 1.482 \times \text{mep} \times \text{gpm} \quad \ldots\ldots 1$$

The constant K in the formula is to allow for inclusion of trapped air, poor oil and turbulence, all of which act to increase the generation of heat. This K value can be as high as 1.4. By careful system design, Ternstedt-Trenton minimizes the K factor to 1.03. In formula 1, the constant 1.482 is the conversion factor to permit using psi and gpm.

Having now computed the two variables—mep and Btu per hour, the yardstick "Y" for pump performance can be evaluated. For example, a ring in a 11 gpm pump lost 5.488 grams in 350 hours. The pressure-time diagram for the cycle showed an mep of 693 psi. Duty load is computed from formula 1.

$$\begin{aligned}\text{Btu per hour} &= K \times 1.482 \times \text{mep} \times \text{gpm}\\ &= 1.03 \times 1.482 \times 693 \times 10.75\\ &= 11{,}784 \text{ Btu/hr}\end{aligned}$$

These variables are now used in the yardstick formula.

"Y" = milligrams loss per 10,000 Btu/hr, per 1000 hours 2

$$= 5488 \times \frac{10{,}000 \times 1000}{11{,}784 \times 350}$$

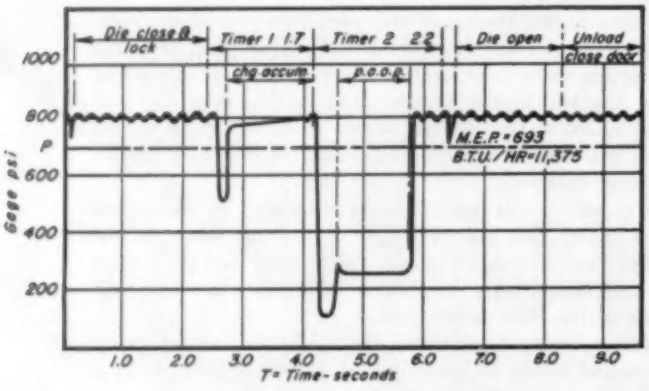
$$\text{"Y"} = 13{,}784$$

Reliability of the answer found from formula 2 largely depends on accurate weighing of the pump ring. Certain precautions must be taken. The ring must be washed and baked for 24 hours at 200 degrees F before measuring weight. This is necessary because the metal is microscopically porous and absorbs the fluid for a false weight.

IN A VANE PUMP, loss of weight due to ring wear is the basis of performance comparison.

Similar weight analyses have been made on pump bushings and vanes. These studies, with fire-resistant fluids, show that the ring accounted for 2.0 percent of the loss which is very high in comparison with vanes at 0.2 percent and bushings at 0.06 percent. Therefore, the pump ring is the logical basis for comparative performance evaluation.

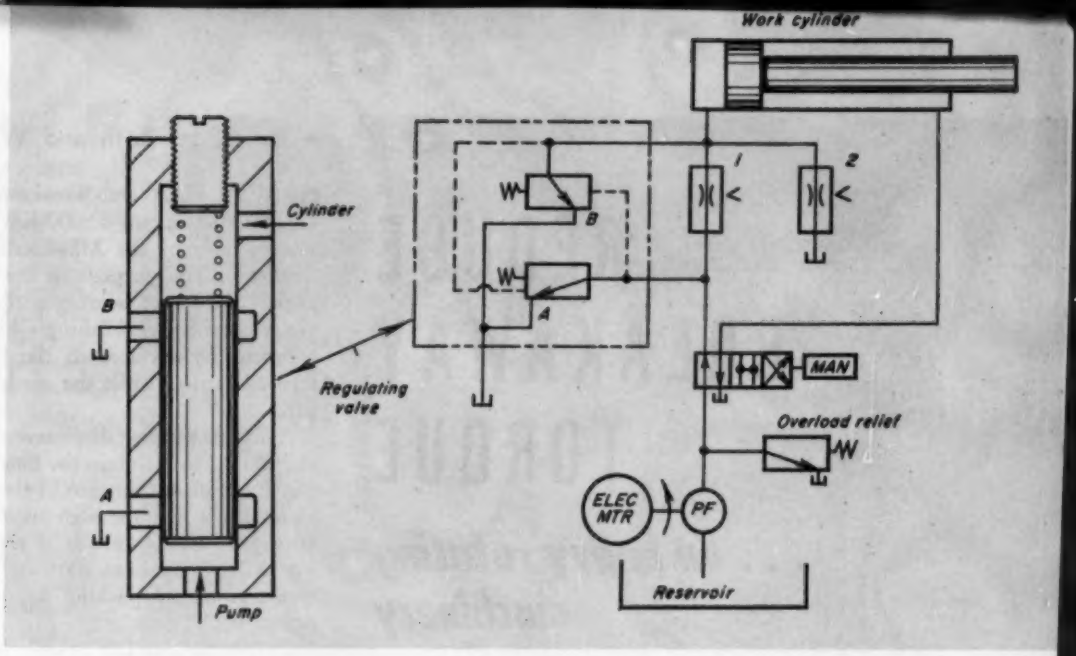
This approach can lead the designer to make circuit changes which will reduce the cycle duty load—this, however, is another story. It is apparent that fluid evaluation and system efficiency go hand-in-hand. The understanding and use of this "Yardstick" evaluation, will promote investigation and analysis for improved design and maintenance. ▼▼▼



PRESSURE TIME curve on a die casting machine cycle. The pump works against a relief valve set at 800 psi except for the time to charge the accumulator and to lift the shot piston out of the pot. Integration under the curve shows a mean effective pressure of 693 psi.

NO.		HOURS	PUMP GPM	PUMP PSI	BTU HOUR	FILTER	RING DATA MGMS.	RING DATA REMARKS	YARDSTICK Y	YARDSTICK Y INCH
4	A	172.5	11	800	11,784	12-100Z	9,378	CRACKED, SUCTION	46,115	52,700
4	A	132.9	11	800	11,784	12-60Z	11,909	BADLY WORN	75,500	86,300
4	A	93.8	11	800	11,784	12-60Z	6,310	WORN	57,200	65,500
4	B	395.3	11	800	11,784	NO	5,488	WORN, W.E.	12,204	14,000
4	B		11	800		NO				
4	A	331.4	75	900	7,483	1-100	894	FAIR	3,607	5,780
4	B		75	900						
22	B	1047.3	75	715	5,057	12-60Z	619	EXTRA GOOD S.R.	1,169	1,871
		1047.3	75	900	7,120	12-60CP	1,035	GOOD S.R.	1,388	2,220
24	B		75	800	5M	12-60C		GOOD S.R.		
			75	900	7M	12-60C		LOST TEST-SHAFT BROKE		
31	B		11	600		12-60C		WORN OUT-REPLACED BY 7.5		
			75	800		12-60C				
10	C	881.7	75	715	4856	12-60N	173	EXCELLENT S.R.	404	645
		881.7	75	900	6750	12-60N	408	EXCELLENT S.R.	686	1098
26	300	3449	75	1100	10,985	1-100Z	848	GOOD S.R.	21.15	33.9
			75	1100		1-100Z				
26	300	2590	75	1000	9,564	1-100Z	39.8	GOOD	15.90	25.4
26	300	1059	75	1000	9,864	1-100Z	45.7	GOOD S.R.	44.65	71.4
11	C.P.	900	75	765	8,420	1-P	9,221	WORN OUT	13,700	21,950
PL.	100	2,300	75	650	3,730	1-100Z	50	EXCELLENT	10.82	17.0

PERFORMANCE DATA for six fluids is consolidated on this chart. Column 1 is the machine number; column 2 is the fluid on test; column 3 is the hours of the test run; column 8 is the laboratory baked out loss of weight of the test ring. Fluids A, B, C are fire-resistant. Fluids 300 and 100 "CP" are petroleum base.



This circuit layout can be used to . . .

CONTROL MOVEMENT AND PRESSURE

• By J. R. Fawcett

SIMPLE screw-down type needle valves used with a specially designed inexpensive regulating valve provide an excellent pressure and motion control circuit for many testing machines. A typical application of this circuit is on a machine used to stretch steel bars for prestressed concrete.

With this circuit, after the work has been contacted, the operator controls motion and pressure by turning the screw-down handle on flow control valve 1. Increasing the valve opening will increase the pressure on the piston as well as the amount of piston travel. Pump pressure varies with the work load and the opening of valve 1, and is a fixed increment higher than the pressure on the piston. This increment of about 20 psi is equal to the spring tension in the special regulating control valve.

For the double acting cylinder, the regulating valve has four ports and a simple cylindrical piston with a spring which controls its movement in one direction so that a differential pressure of about 20 psi has to be applied for it to open to port A. The movement in the other direction is unrestrained and any reverse flow is discharged through port B.

With valve 1 fully closed, the whole pump output is passed through port A to tank at a pressure of 20 psi. To control the cylinder, valve 1 is opened. If it is desired, as is usually the case with this circuit, to build up to a given pressure, the cylinder will move until it meets the resistance of the testing machine specimen or wire, and the pressure will start to build up. The cylinder pressure also acts on the spring side of the regulating valve and augments the spring in opposing the pump discharge through port A, so that as the cylinder pressure builds up, so does the pump pressure.

To take some actual figures—the spring gives a blow-off pressure of 20 psi, and the cylinder pressure. If a higher pressure is needed, valve meets a resistance which causes the pressure to build up to 50 psi. This pressure is applied to the regulating valve and increases the blow-off pressure to 70 psi. If a higher pressure is needed, valve 1 is opened further. Pressure at 70 psi is admitted to the cylinder line and the pressure increases; as it does, the pump delivery pressure also increases by exactly the same amount. The pump never works at more than 20 psi above the cylinder pressure.

To release the pressure slowly, another screw-down valve 2 must be provided. A manually operated 4-way, three position valve is used for reversing. The regulating valve is designed to automatically discharge oil from the cylinder blank end to tank through port B without passing the oil through the 4-way valve. The plunger in the regulating valve is free to move under the back pressure from the cylinder once the operation of the 4-way valve has opened the valve pressure inlet to tank.

Because the special regulator valve automatically builds up pressure as long as the screw-down valve is open, an overload relief valve must be used.▼▼▼

REDUCE BREAKAWAY TORQUE

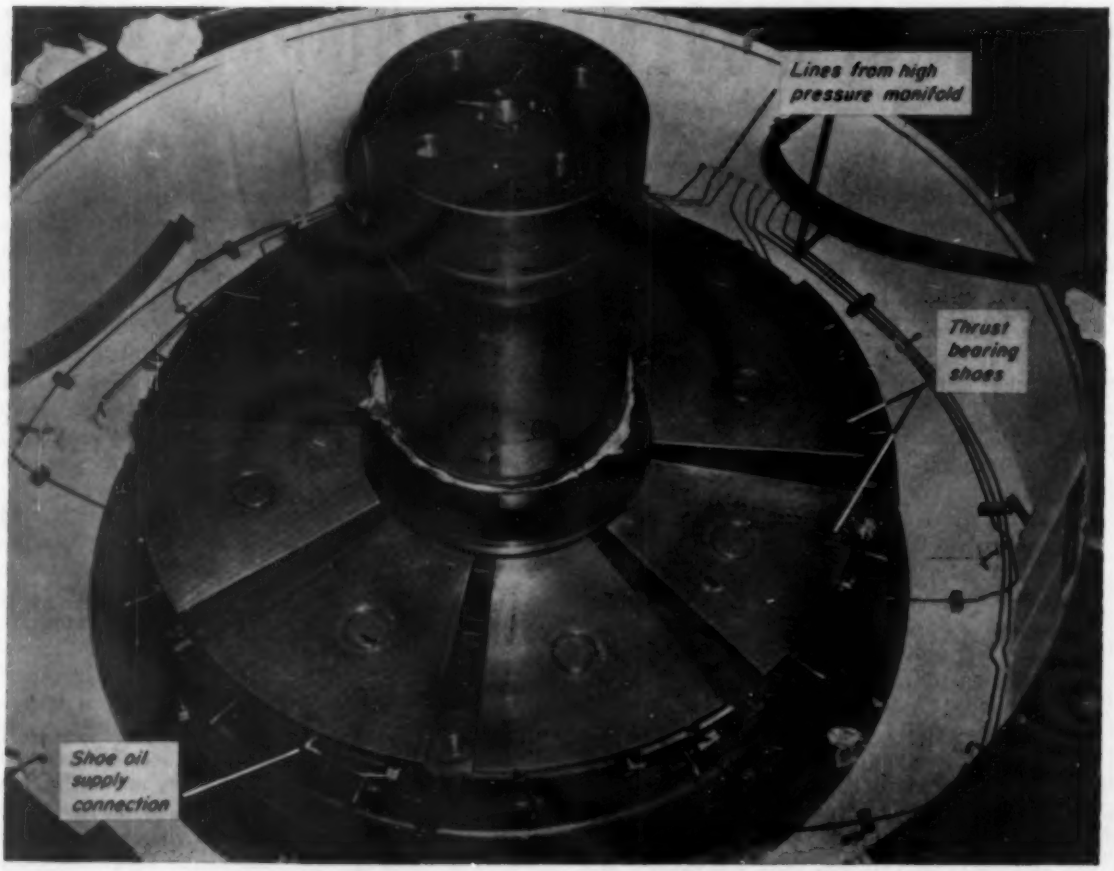
. . . on heavy rotating machinery

• By H. H. Roth and W. B. Cart

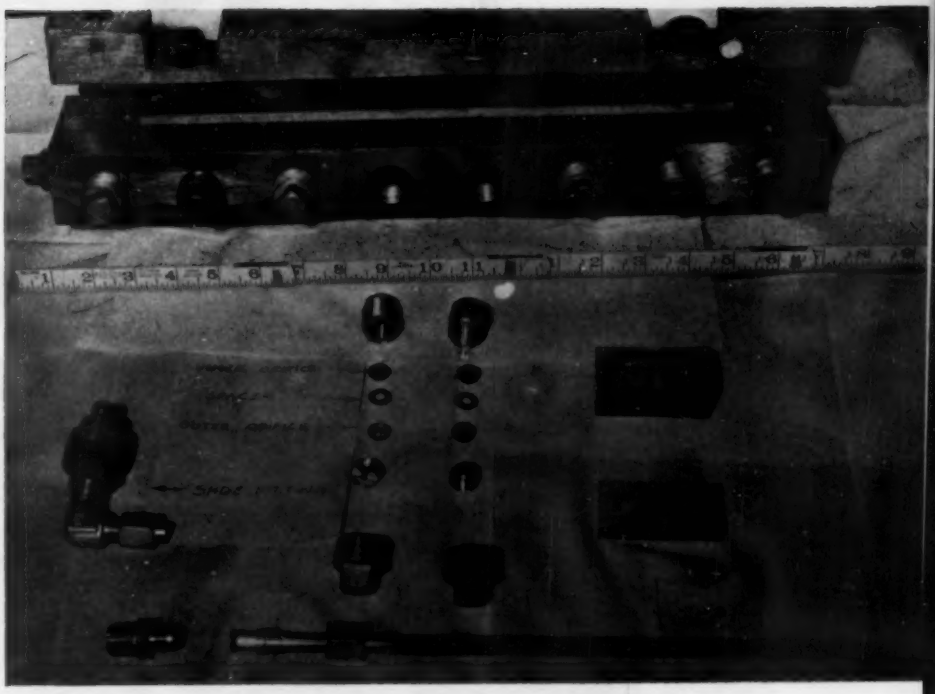
PRACTICALLY zero breakaway torque has been achieved on two 80,000 KW hydro-electric generators built by the Allis-Chalmers Manufacturing Company. The purpose in the application was to protect the thrust bearing surfaces from dry starting friction by establishing a high pressure oil film between the surfaces of the 85½ inch diameter thrust bearings while the machines are at a standstill.

A 7 gpm positive displacement pump supplies oil at 1000 psi to maintain the film in each thrust bearing. Experiments on each of the two generator units showed that with the high pressure systems in operation, breakaway torque is reduced to a value so low that two men can start the 1,637,000 pound rotors turning by pushing against the rotor spider arms.

This technique can readily be applied to reduce forces between heavy rotating or reciprocating machine members. ▼▼▼

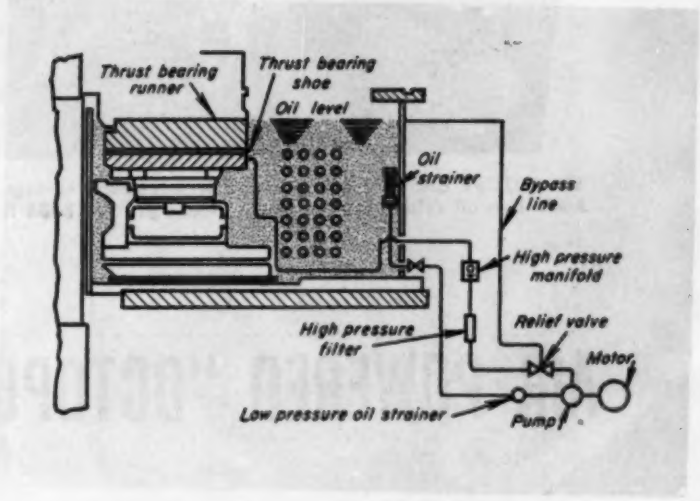


SEPARATE HIGH PRESSURE OIL LINES extend from the manifold to each of the eight bearing shoes. The oil passes through internal passages in each shoe to an outlet near the center of the shoe's babbitted surface. A circular groove in the babbit assists in distribution of the oil over the shoe surface. Lines are thick walled steel tube, designed to keep the number of connections inside the oil reservoir at a minimum. The supply line into each shoe is bent at a right angle and held by a slotted cleat to the support ring.

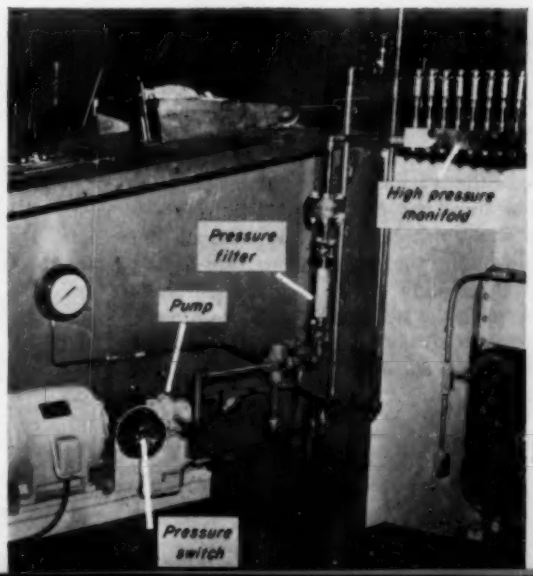


HIGH PRESSURE MANIFOLD ASSEMBLY DIRECTS an equal amount of flow from the pump to each of the bearing shoes. The orifice plates meter the oil to the shoe supply lines. A pair of orifices is placed in the back of the manifold at the entrance to each of the eight supply lines. The excess capacity of the pump, which delivers double the quantity of oil required to establish an oil film in the shoes, is used to assure the desired pressure at the entrance of the each orifice with all orifices carrying their maximum quantity of oil. This provision assures an adequate supply to each shoe, even though the required pressure at individual shoes may vary over quite a range.

The pipe plugs in the front of the manifold provide access to the orifices for inspection or replacement.



SCHEMATIC OF THE HIGH PRESSURE oil system. Oil is taken from the bearing oil reservoir at a point near the normal oil level. The oil passes through two strainers in series before entering the suction side of the high pressure oil pump. The pump delivers oil at a pressure exceeding 1000 psi in an amount approximately double the amount required to maintain sufficient oil film thickness in the particular bearing. A pressure relief device, together with a bypass line, is provided to bypass the oil not required by the bearing. After leaving the pump, the oil passes through a high pressure filter to remove any sediment from the oil before it reaches the bearing shoes, then enters the manifold which is external to the bearing housing.



POSITIVE DISPLACEMENT PUMP is stopped automatically when the generator reaches a predetermined speed, approximately 50 rpm. It also starts automatically at the same speed when the generator is being shut down. The high pressure system operates only while the generator is being started or stopped. The pressure switch prevents starting the generator unless the high pressure system is operating. In addition to the line filter on the pressure side, which is rated to filter to 40 microns with a maximum pressure of 5000 psi, there are two strainers in series in the suction line. A pressure snubber in the line to the gage protects the gage against surges. A handwheel on the relief valve regulates the operating pressure.

TO ADJUST CASTER AND CAMBER, suspension springs must be compressed to simulate actual highway load. Two oil cylinders with 8-inch stroke provide 3454 lb. each to compress the springs.

AIR POWERED "OCTOPUS" *grips auto chassis*

FREQUENTLY a large-force application is required where the use of shop air supply and an air-oil booster is the most economical source of power. In Ford Motor Co. assembly plants, speed of production, and the uninterrupted flow of units through the various stations are essential. Each function must be geared to the entire operation, and a shut-down at any point means an immediate slow-down for the entire plant. One of the operations is installing the front wheel suspension and compressing the two front springs in order to simulate actual highway load in adjusting the caster and camber of the wheels. This job is done with an air-oil fixture having four air cylinders which lock the fixture in place and two larger oil cylinders which compress the springs. The tool, nicknamed "Octopus" because of its appearance, permits setting both front wheels for caster and camber at the same time.

The fixture is locked to the chassis by four air cylinders which actuate locator clamps, that reach underneath the frame side member. When the cylinders are fully extended, they actuate limit switches to indicate the fixture is locked. The suspension springs are then compressed by two oil cylinders set at the same angle as the springs. These cylinders have a 2½-inch bore and an 8-inch stroke and develop 3454 lb thrust each at 705 psi pressure from

the booster. The booster, oil tank, air filter unit, and air gage are mounted overhead near the fixture.

As the chassis with front suspension partially assembled moves into position on the conveyor, the Octopus suspended from a small overhead crane is located and lowered onto the chassis. The operations of the fixture are controlled by pushbutton switches mounted in a box on the fixture. Separate pushbutton switches are used to lock the fixture in place, compress the suspension springs, release the springs, and unclamp the fixture. When the fixture is clamped in place, spindle locators on the sides of the fixture are manually positioned over the front wheel spindles to position them in the proper camber-caster setting. As this is done, a limit switch is tripped to lock the electrical circuit and prevent undesired operation. A green light on the pushbutton panel indicates when the shafts are retracted and the fixture can be operated.

ELECTRICAL CIRCUIT

The 110-volt electrical control circuit is energized from a 440-volt line by a .5 kva transformer. A manual disconnect and two 3-ampere fuses protect the primary circuit. The secondary is protected by two 10-ampere fuses.

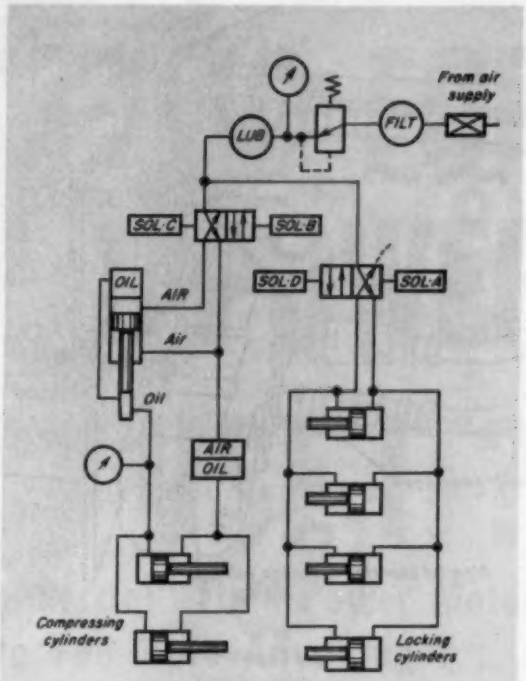
When the fixture is lowered into position on the chassis, the "lock" pushbutton is pressed actuating relay 1-CR which energizes solenoid A to extend the lock cylinders. Limit switches 1 through 4 are closed by the extended lock cylinders. Limit switches 5 and 6 are held closed and relay 3-CR is actuated when the shafts are pulled out. The green light is then energized indicating that the fixture can be operated.

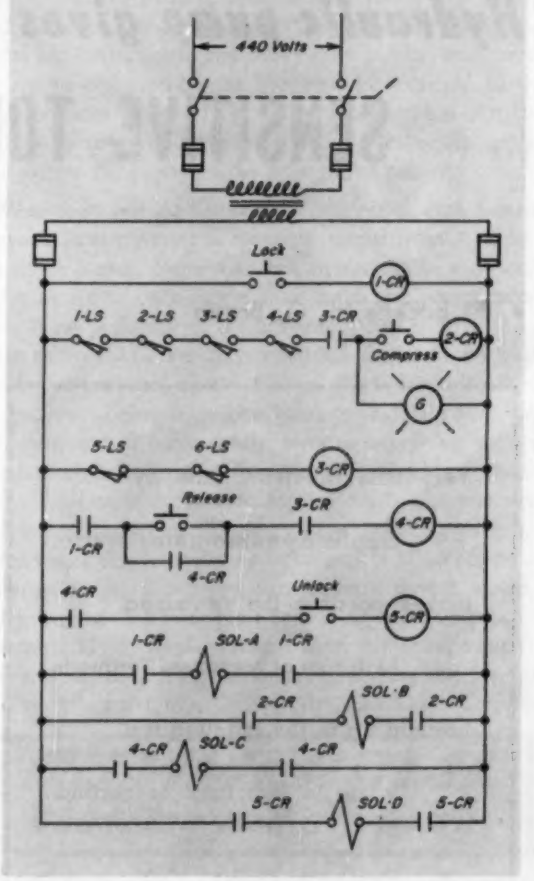
Pressing the "compress" pushbutton actuates relay 2-CR to energize solenoid B and extend the compressing cylinders. The side shafts are then manually pushed in locking out the electrical system. The extended shafts allow limit switches 5 and 6 to open deactuating relay 3-CR. Contacts of relay 3-CR in series with relays 2-CR and 4-CR which has contacts in series with relay 5-CR prevent electrical operation of the fixture while adjustments are being made.

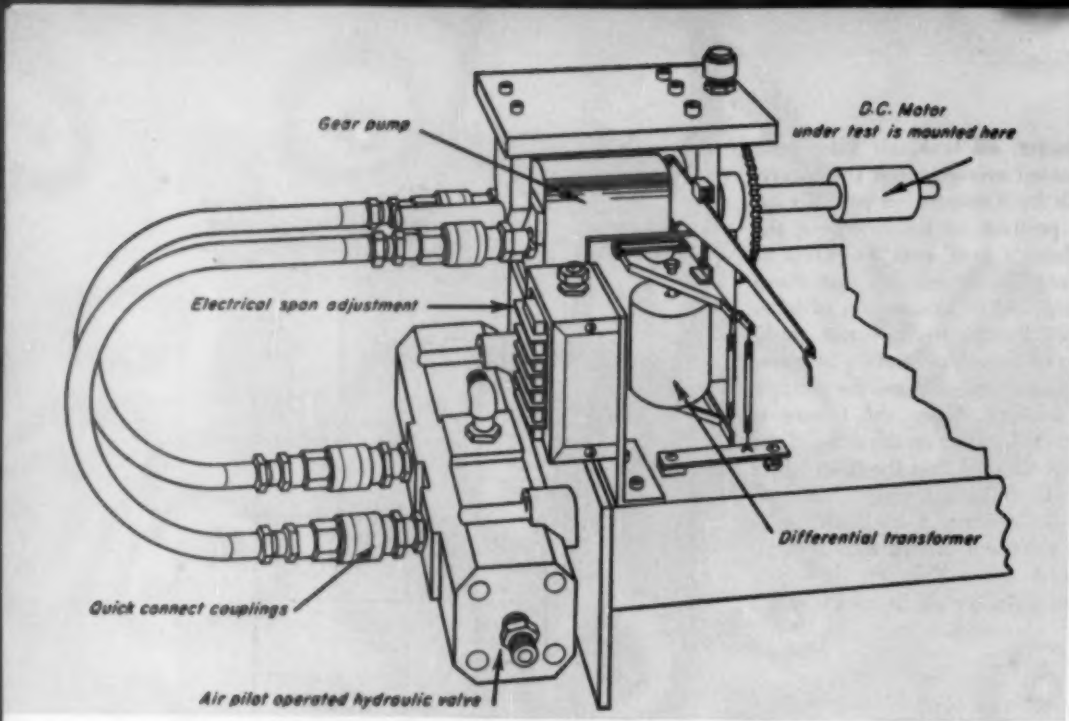
After completing adjustments, the shafts are pulled out actuating relay 3-CR again and the "release" pushbutton is pressed. This actuates relay 4-CR which locks in and energizes solenoid C to retract the compressing cylinders and the booster. The "unlock" pushbutton is then pressed to actuate relay 5-CR energizing solenoid D to retract the locking cylinders.

When relay 1-CR is actuated at the beginning of the next cycle, it deactuates relay 4-CR. As a safety feature, normally-open contacts of relay 4-CR are in series with relay 5-CR which retracts the locking cylinders. Thus the fixture cannot be unlocked unless relay 4-CR is actuated and the compressing cylinders are retracted.

Two men make the necessary installations and adjustments to the wheels. ▼▼▼







A POSITIVE displacement rotary pump develops reaction torque as a linear function of discharge pressure. By trunnion mounting the case assembly and measuring the force produced, total output torque produced by the actuator under test can be measured.

Hydraulic pump gives fast response for...

SENSITIVE TORQUE MEASUREMENT

• By Eugene H. C. Brown

Very little inertia of the hydraulic dynamometer system makes possible the required high rate of response. Torque is brought up to the required test value in less than ½ second.

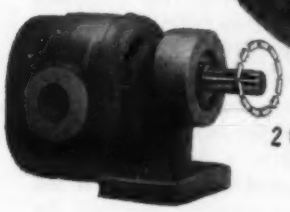
HIGH speed of response when measuring torque developed by small electric actuator motors is accomplished by using a hydraulic pump circuit on a production test stand developed by Industrial Engineering Corporation.

The motors under test are reversible, D.C. motors which drive through a gear reducer. Limit switches on the output shaft control reversal. In most cases, operation of the motor is limited to only 76 revolutions in either direction at the output shaft. Since the average speed is 1200 rpm, the time of operation is very small. Obviously any torque control system to be used to test these devices must have a very high speed of response in order for the test to have any meaning. With only 3 to 4 seconds total time involved, the dynamometer system must bring the torque to the desired test value in the order of one-half second with a response curve showing only 3 cycles around the control point before leveling off. In other words, the control system

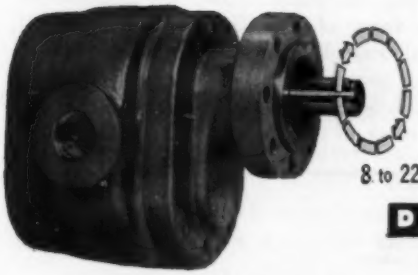
EUGENE H. C. BROWN, *Director of Engineering and Research, Industrial Engineering Corporation, Louisville, Ky.*

YOU'RE PAYING FOR OIL HYDRAULIC POWER-WHY NOT USE IT?

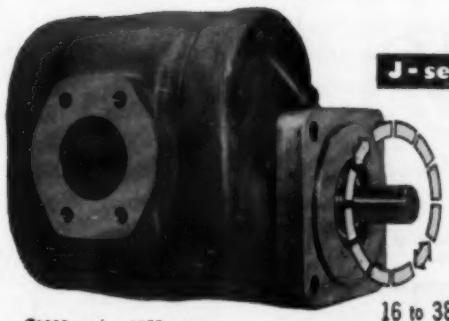
"Commercial" Fluid Power Motors Give You More Advantages . . .



2 to 6 HP* **C-series**



8 to 22 HP* **D-series**



J-series

16 to 38 HP*

*1000 p.s.i. – 1500 r.p.m.

Power where and as you want it—Now you can directly apply power for rotary motion without disturbing the location of the driven mechanism, because fluid power can be piped for distance and around corners. "Commercial" oil hydraulic motors are built for rugged heavy-duty service, and because they are so compact can be mounted in restricted hard-to-get-to locations. Speed can be varied and direction of rotation reversed—giving you advantages and flexibility for applying all or part of the power of the basic prime mover.

What they will do for you—Three series, each furnished in several sizes covering a range of output from 2 to 68 hp for a single motor. More than one motor can be mounted in tandem as a unit on a single shaft for larger power requirements. New performance is built into "Commercial" oil hydraulic motors—all are recommended for continuous duty operation at pressures up to 1500 psi. New dependability has been proven . . . extra large gear bearings maintain shaft alignment, every motor has a special built-in heavy-duty outboard bearing to absorb all drive shaft and shock loadings, and new leakproof oil seals prevent leakage. Here is a power source which is practical to install; giving dependable long life operation at a cost that has resulted in savings in hundreds of different applications. Don't you want to learn how it would be more practical to power your operating mechanisms with "Commercial" hydraulic motors than any other system of power transmission? The Commercial Shearing and Stamping Co., Youngstown, Ohio; Chicago, Ill.; Salt Lake City, Utah.

POWER PACKED MOTORS

Pumps • Motors • Valves • Cylinders

COMMERCIAL
shearing and stamping

Products Preferred by Customer Acceptance

KA-69

must produce one-quarter damping ratio.

An electrical dynamometer system, even assuming that the control system could be designed, is out of the question because the saturating time for the dynamometer field would be such that quarter damping ratio at this speed or response is impossible. By the use of a positive displacement hydraulic pump almost instantaneous response can be obtained due to the fact that the hydraulic system has very little spring rate or mass involved.

The hydraulic system is very simple. A standard gear type pump is driven by the actuator under test. The pump is trunnion mounted and restrained by a torsion bar. The motion of this torque assembly is transmitted to an electronic controller and recorder mounted on the panel. Motion of the torque assembly is a direct function of torque produced at the hydraulic pump input shaft. This is of course a measure of the output torque from the actuator.

THROTTLING VALVE CONTROLS PRESSURE

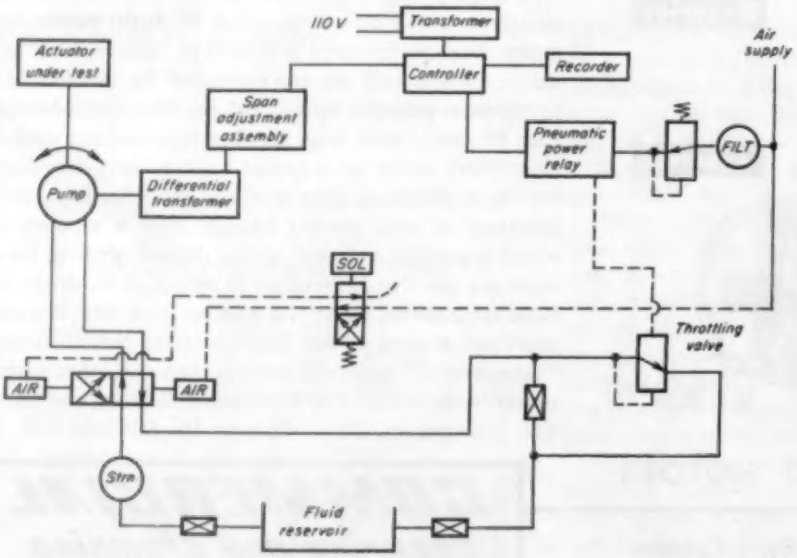
Since torque produced is a function of the pounds of fluid pumped and the pressure, the speed of rotation of the input motor has no effect on the torque measuring system other than possibly to raise the minimum controllable torque available for a given system due to the limiting head value of the fluid flowing through the hydraulic lines. The back pressure or head produced by the hydraulic pump is controlled by the pressure compensated high speed throttling valve positioned through a pneumatic electric relay controlled by the signal from the controller. Since torque must be measured in either direction of rotation, a relay is used to reverse automatically the torque transmission signal, the four-way valve controlling the direction of fluid flow and to start and stop the high speed recorder chart as well as starting, stopping and reversing the motor under test.

The two position, 4-way valve is air piloted operated for reversal. Reversal is necessary whenever the actuator reverses so that the pump is properly loaded by the back pressure created at the throttling valve. The throttling valve is the most critical component in the fluid circuit. An attempt was made to use commercially available items at this point. A valve with the fastest speed of response available was found to require approximately 10 times the response time required. As a result, a valve was designed to regulate back pressure. The response time of this valve is in microseconds.

With this valve and the electronic control, reset rates of 1,000 repeats per minute are attained. Inertia in the hydraulic system is the controlling factor. In the final test stand design, torque is recorded on a high speed chart using a pen response time of 2/10 second for full chart travel. This recording system produces square wave recording and shows less than one-quarter of one per cent deviation from the control point at any point on the scale.

Torque measurement is actually carried out by measuring the movement of the pump housing. This mechanical movement fed to a differential transformer produces an electrical signal which is fed through a span adjustment assembly and into the controller and recorder.

Running torque measurements for the actuator motors over the range of 3 to 15 inch pounds can be recorded and controlled without adjustment of range. By using maximum range span, 25 inch pounds torque can be measured and controlled over an input speed range of 600 to 1400 rpm. ▼▼▼



LOADING of the hydraulic pump is accomplished by the throttling valve. Response time of this valve is in microseconds.

(*Advertisement*)

Report to Cylinder Users . . .

Here at Miller Fluid Power we have a pattern which we follow. A goal at which we are shooting. The pattern isn't too simple. And the goal isn't an easy one. But we've been making progress. Our position right up in the van of the industry proves that.

Our job is the production of cylinders. Basically, there's nothing anyone can do to alter a cylinder. It was old a hundred years ago. It probably won't change basically in another hundred years. But in the details of the cylinder, change is the major element.

Which is very much like industry itself. Basically industry has not changed since free enterprise was conceived on this continent. But in every detail it changes from year to year.

It's the Thousandths That Count

There was no single big thing wrong with the cylinders being manufactured yesterday. Just a lot of little things. So Miller Fluid Power made the improvement of little things its business.

We experimented with new materials and made safer, more dependable steel heads and caps. We hard-chrome-plated 110,000 PSI yield point steel to improve radically the piston rods. We raised the efficiency of operation to new peaks. Striving for quality in the smallest detail we improved in a dozen parts which are hidden from sight.

For instance, most cylinders leaked in operation. Miller made one that wouldn't leak. To prove it, we went away out on a limb and guaranteed leak-proof operation. And made the guarantee stand up.

We Learn by Listening to You

We saw our customers as thousands of men in thousands of shops wrestling with thousands of production problems. We made those problems ours and produced cylinders to whip those problems. Maybe we didn't revolutionize the cylinder business in the process. But we sure helped. We know that.

We learned to produce what we believed was the best cylinder on earth. We also learned that the best cylinder today wouldn't be good enough tomorrow. So, with the good one in production, we listened some more, experimented, and came up with a better one.

Miller Fluid Power is a young company in an old field. We are young, progressive, and willing to listen. We innovate without being prodded.

Discussion is a Two Way Street

On occasion we like to have others listen to us. Especially when what we have to say will help our customers. That is the idea behind our College of Cylinder Knowledge. We know a lot about cylinders. Though not as much today as we will tomorrow or the day after.

In our College of Cylinder Knowledge we try to show you what good cylinders can do for you. And what you should demand in any cylinder you buy. We meet other men who know what they want in a cylinder. We listen to their wants and try to explain what perfection in detail means.

We believe that when the users of cylinders sit down across the table from the producer who is trying to make the best, better cylinders result.

We'll be carrying that belief into the Production Engineering Show at Navy Pier in Chicago on September 6. Our College of Cylinder Knowledge booth will be open for that kind of discussion. We'll listen and learn.

The only way we can learn is from you. We can help you. But not until you've dropped that problem of yours in our lap. Your problem contains the stuff of which the better cylinder will be made. The cylinder that will have that quality plus which we like to think is the stamp of Miller Fluid Power.

Remember this when you see the sign over Booth 1819-23. We'll be there to listen to your suggestions, demands and questions. Also, because we are in the cylinder business, we'll be there to show you a cylinder you will want to buy.

Frank Flick

President

MILLER FLUID POWER COMPANY

2008 N. Hawthorne Avenue

Melrose Park Illinois

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Production Engineering

NAVY PIER SHOW CHICAGO

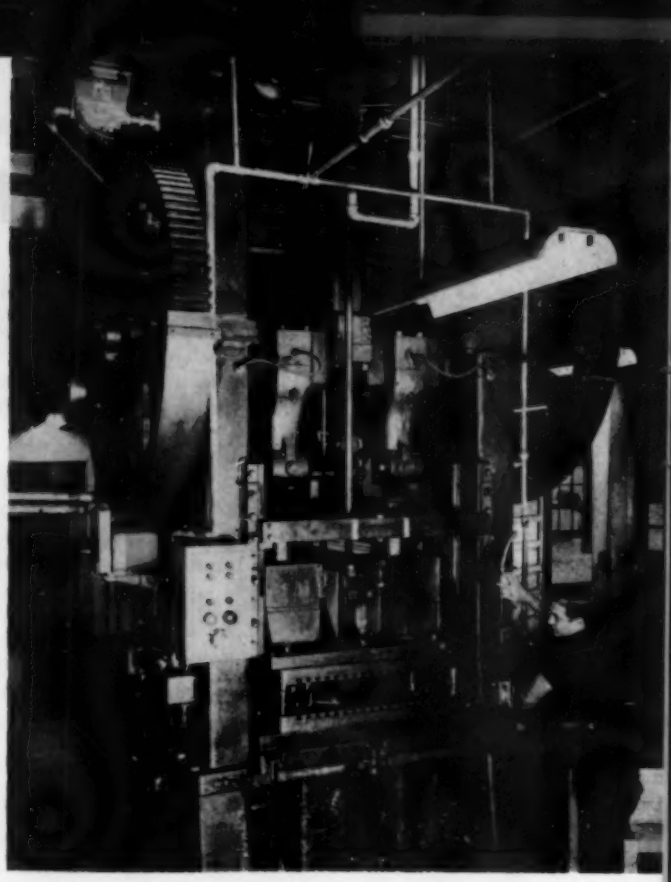
Circle 62 on Reader Service Card

Electro-pneumatic control

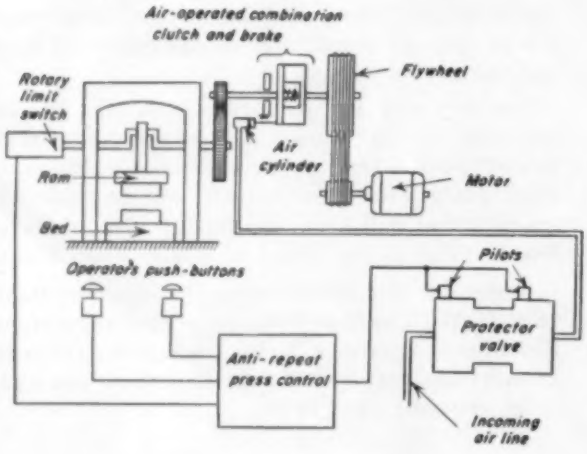
PRESS SAFETY

THE basic principle of press safety is to ensure that the operator's hands are not caught by the descending ram. Frequently operators have ways of "outsmarting" simple controls installed for their safety, so it is necessary to go to more complex designs for foolproof protection. A transistorized electrical control unit combined with a special, solenoid-controlled, pilot-operated air valve both developed by Clark Controller Co. provide this protection on presses equipped with a spring-loaded, air-operated clutch and brake.

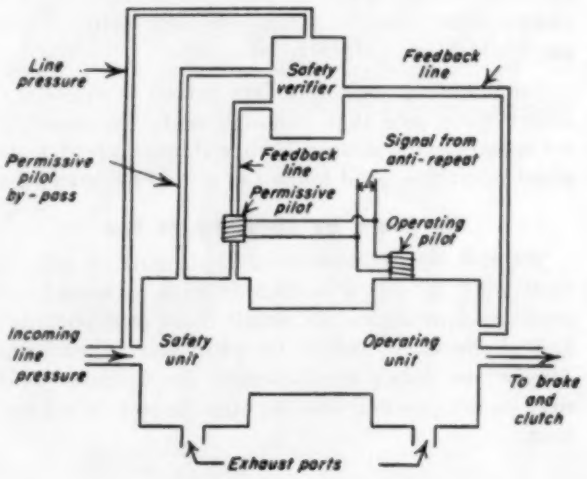
During safe conditions, the electrical anti-repeat control energizes the valve to engage the press clutch and operate the press. To provide the signal, the operator must hold two pushbutton start switches with both hands during the dangerous part of the ram down-stroke, and since he must release them before the end of the up-stroke, they cannot be tied down. ▼▼▼



SPECIAL VALVE mounted above large gear at left guards against failures which might allow ram down-stroke when operator is handling work. Valve is actuated by transistorized anti-repeat control.



PROTECTOR VALVE prevents repeat operation of press during unsafe conditions in a system as shown above. Pushbuttons must be depressed to start press moving and held during dangerous part of press down stroke. Pushbuttons energize anti-repeat control which actuates solenoid to open valve. Valve admits air pressure to disengage brake and engage clutch. Limit switches are actuated at various points in ram travel to ensure pushbuttons are depressed and released at proper times.



BASIC ELEMENTS of the valve are the operating unit and pilot, the safety unit and permissive pilot, and a safety verifier. Both pilots are operated by solenoids actuated by the anti-repeat control. The operating pilot controls the operating unit. Under safe conditions, the permissive pilot permits the press to operate by blocking the feedback signal which would operate the safety unit to shut off air pressure. The safety verifier operates if the safety unit permissive pilot fails.

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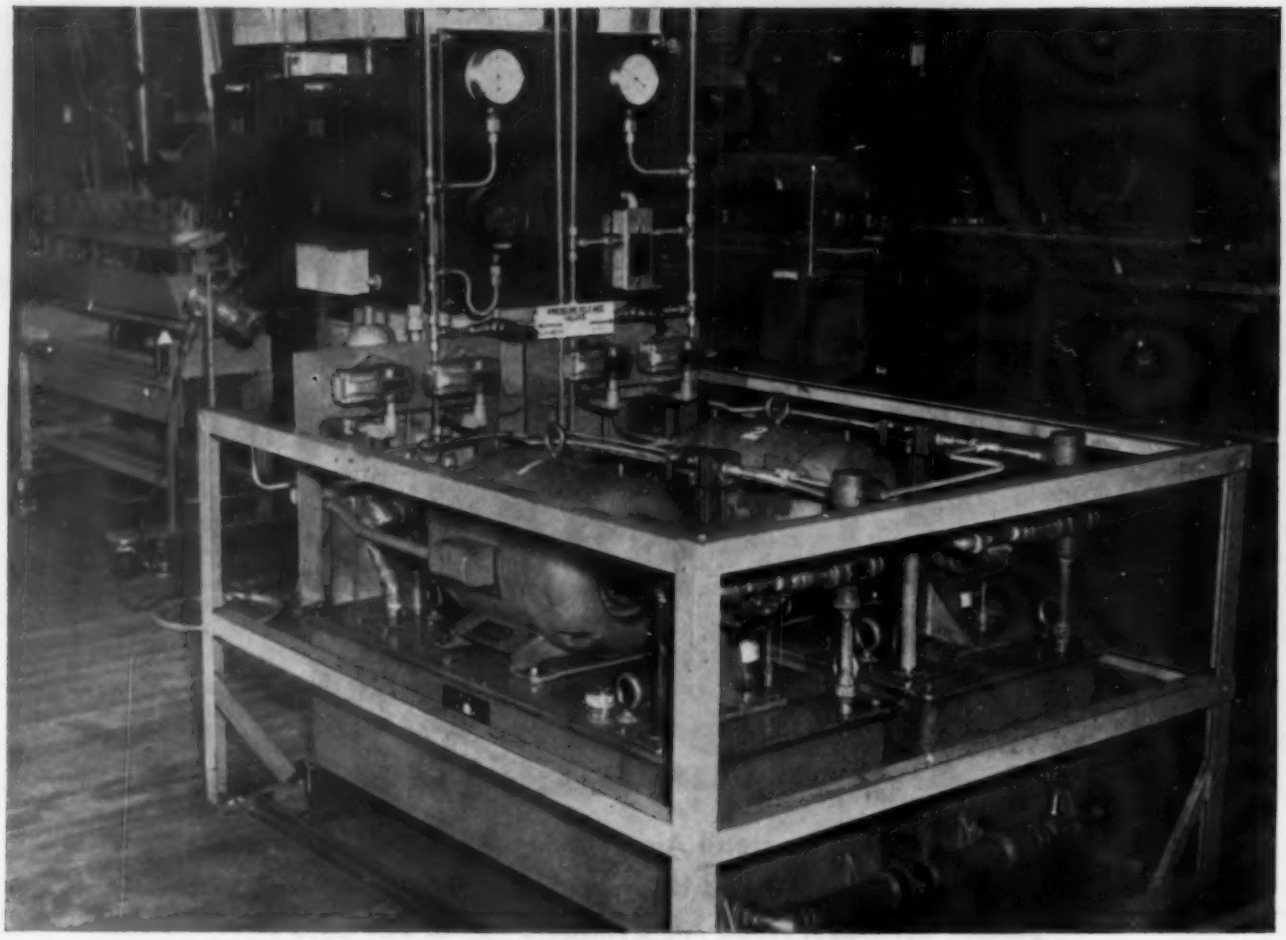


DESIGN OF A TWO PRESSURE HYDRAULIC

• By W. S. Templeton

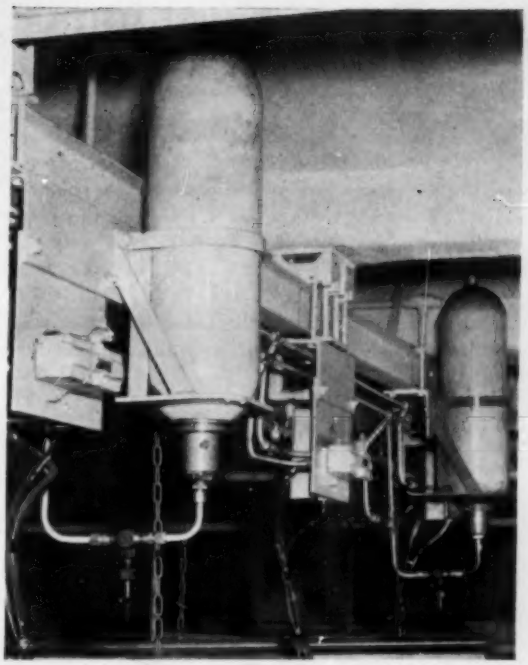
WHEN approached with a request for a dual pressure hydraulic system, this is what the factory planning department at Northern Electric Co. Ltd. designed. The high pressure system was to be 1500-2500 psi with a flow of 5 gpm and the low pressure system was to be 1000 psi with 1 gpm flow. That was it—no strings and no restrictions. This was a definite challenge, because although this group had installed an abundance of hydraulic machinery, they had never designed a complete hydraulic system. The best obtainable system at the cheapest possible price was wanted, and ultra-reliability was a must, because a considerable amount of equipment would be dependent on the output of the system.

The function of the high-pressure system is to supply 12 clamping tools. The function of the low-pressure system is to supply 2 cut-off tools and a card wiring machine. The clamping tools require 1500 psi or higher, and the cut-off tools and card wiring machine require 800 psi.

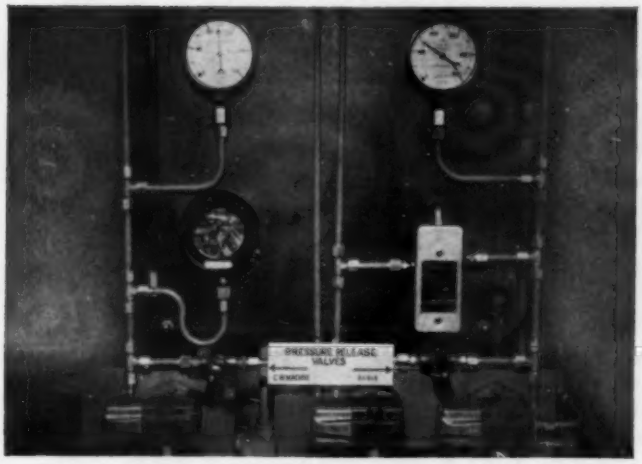
Two complete dual systems, each incorporating high and low pressure pumps, are mounted on in-

W. S. TEMPLETON, Asst. Superintendent, Factory Planning & Methods Engineering, Northern Electric Co., Ltd., Montreal, Canada.

HIGH PRESSURE ACCUMULATORS are shown with two-position valves which control clamp tools. One accumulator serves each pair of clamp tools.



MERCURY-CONTACT pressure switch is in low-pressure circuit. Metal-contact pressure switch is in high-pressure circuit. Hand-operated globe valves release system pressure for checking accumulator pre-charge pressure.



Several thousand dollars worth of hydraulic equipment went into this tooling set-up. This was the first big hydraulic design job taken on by the company's factory planning engineers who solved the problems of layout and component selection.

SYSTEM . . .

dividual supply tanks which are interconnected. The dual systems are exact duplicates. One system is regarded as a standby, but is run one day per week to prevent oil stagnation in pumps, valves, and lines.

HIGH-PRESSURE SYSTEM

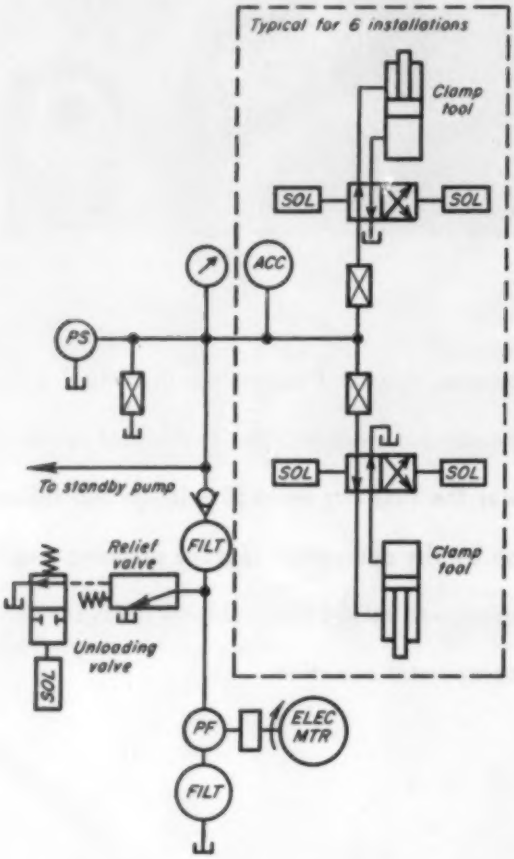
In the high-pressure system, oil is drawn into the piston-type pump via a filter mounted in the tank on the suction side. The pump delivers oil to the relief valve, and then through the check valve. The oil is then in the closed high pressure system and cannot return via the pump.

The relief valve is the balanced piston type and in addition to limiting the pump pressure, the valve can be opened to tank by venting. This is important, because it is undesirable to have the pump under load when the system is fully charged. The two conditions of the valve permit the pump to deliver oil under pressure to the system, or to deliver oil at zero pressure back to the tank.

Selection of the appropriate relief valve function is made automatically by the pressure switch which controls the unloading valve. When the pressure in the system reaches the high limit, the pressure switch deactuates the solenoid-operated unloading

valve, venting the relief valve and unloading the pump. When the pressure in the system falls to the low limit, the pressure switch actuates the solenoid valve. This stops the venting fluid from the relief valve and closes the relief valve to tank directing the pump output to the pressure line instead of the drain line.

Although these pumps are rated for continuous operation, it was considered advisable to introduce



HIGH-PRESSURE SYSTEM. One accumulator serves each pair of clamp tools which are controlled by two-position solenoid valves. Check valve prevents loss of system pressure while pump is unloading.

this additional control in order to increase pump life and reliability. The shorter time of operation under load also effects a savings in power consumption and reduces heating of the hydraulic fluid.

The pressure switch is set to provide the required operating differential giving a low of 1400 psi and a high of 1600 psi. The highest practicable differential is used to obtain the best possible operating conditions by the reduction of stops and starts of pumps, switches, and solenoids. To protect the systems, the relief valve is preset to slightly above maximum operating pressure.

Oil is delivered under pressure to the accumulators which give a stable pressure supply. By storing oil under pressure in the accumulators, it is necessary to operate the pump only long enough to maintain pressure in the system. The accumulators are the gas-oil type and are pre-charged with dry nitrogen. They are installed in the line at suitable points and supply oil to the clamping tool cylinders through a two-position, solenoid-operated, directional control valve. This directs oil to the appropriate side of the cylinder for clamp and release. Individual valves are provided for each tool.

LOW-PRESSURE SYSTEM

The low-pressure system operates similar to the high-pressure system, except that a mercury-contact pressure switch is used instead of the metal-contact type. The mercury switch requires less maintenance and is efficient for pressures below 2000 psi.

SAFETY FEATURES

All possible safety precautions have been taken in the design of the system. All pipe lines were tested at 3000 psi steady pressure and 7000 psi or more surge pressure. High capacity, balanced-type relief valves were installed in each pump circuit. Aircraft-type high-pressure, flexible lines and fittings were used. Vinyl sheathing was installed over flexible lines to divert oil flow in event of leakage.

MAINTENANCE

Except for a daily check of oil level, the only maintenance required is the monthly check on accumulator pre-charge pressures. Pre-charge pressure on the high-pressure accumulators is 1250 psi, and the pre-charge pressure on the low-pressure accumulator is 800 psi. When checking these pre-charge pressures, all system pressure is released at the appropriate bleed valve below the instrument panel. In the low-pressure system, pressure must be released from the accumulator through a bleed valve at the base of the accumulator. The cap of each accumulator is removed and the pressure is checked with a gage screwed into the accumulator nipple.

If the pre-charge pressure is low, one end of the pre-charging hose is connected to an oil-pumped nitrogen bottle and the other end is connected to the gas valve on the gage. Nitrogen is admitted until the gage reads the desired pressure. The accumulator cap must be screwed on tightly because a loose cap can permit a slow leak past the pre-charge valve.

During operation, personnel have been instructed to watch for changes in normal pressure limits, erratic operation of pressure switches such as rapid repeat operation, leaks, and unusual noises. The

Continued on page 60

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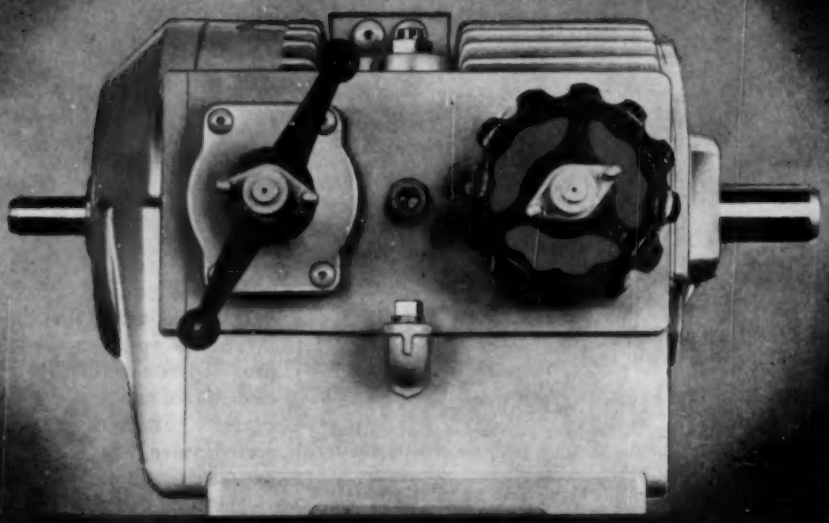

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DESIGN OF A TWO PRESSURE SYSTEM

Continued

most vulnerable components are the pressure switches and the valve solenoids.

System cleanliness is a must for good operation. All large foreign matter in the tank will be caught by the filter on the suction side, and micronic filtering is effected by the unit on the outlet side of the pump. As the filter on the pressure side does not protect the pump, cleanliness in filling and preparing the reservoir is essential.

SELECTION OF COMPONENTS

Past experience on variable volume piston pumps indicates that, desirable as these may be from the system simplicity aspect, they are expensive and slightly temperamental. We felt they might not be desirable for a low pressure, repetitive industrial operation. As cost and possibly other considerations precluded a variable volume pump, a fixed displacement vane-type pump was selected for the 800 psi system. For the high-pressure system where pressure could go as high as 2500 psi, a piston-type pump was required.

It was estimated that the pumps would be operating under pressure about 30% of the time. This provided ample time for cooling without resorting to heat exchangers even with a modest reservoir capacity. For venting, a single-acting solenoid-operated valve was selected for both high and low pressure systems.

The high-pressure system operates 12 individual clamping tools arranged in groups of 2. Six accumulators are provided to minimize the delay due to time losses. The accumulators are connected, so that they all feed a common line, but each can be isolated for removal without interference with the operation of the system. A single accumulator is incorporated in the low-pressure system.

Two-position, 4-way solenoid valves direct oil from the high-pressure accumulators to the tool cylinders, or from the tool cylinders to the drain return lines. The solenoids of these valves are actuated by limit switches on the clamping tools.

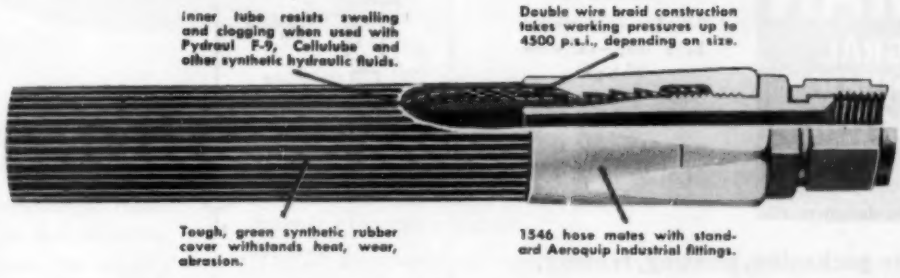
The pumps operated by a 7 hp motor, are considerably overpowered at 1500 psi. However this provides ample power in case the high pressure is increased to 2500 psi. The pumps and motor are mounted on a 30-gallon reservoir.

A ½-in SAE 1010 soft annealed pipe line is used throughout for rigid lines except for the connection between unloading valves and relief valves. A ⅜-in line is used for this connection. Double-seal globe valves are used throughout. These incorporate a positive seal before the gland in the full open position. Flexible line is used between the double solenoid, directional control valves in the high-pressure system and the clamping tools. These are encased in a loose sheath of clean vinyl plastic which protects workers against oil leaks. The lower end of the vinyl

Continued on page 62

Reduce Fire Hazard!

New! Aeroquip 1546 High Pressure Hose for FIRE-RESISTANT Hydraulic Fluids


inner tube resists swelling and clogging when used with Pydraul F-9, Cellulube and other synthetic hydraulic fluids.
Double wire braid construction takes working pressures up to 4500 p.s.i., depending on size.
Tough, green synthetic rubber cover withstands heat, wear, abrasion.
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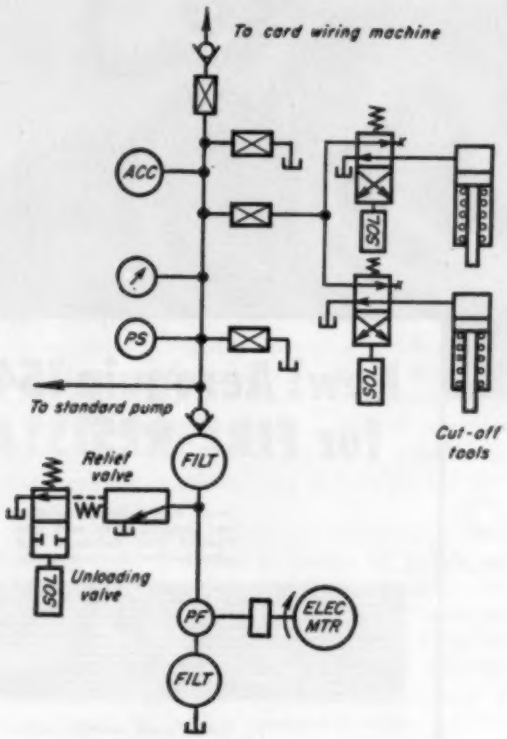
DESIGN OF A TWO PRESSURE SYSTEM

Continued

sleeve is left open so that leaks can be easily detected. Steel rather than brass unions are used to connect the flexible hose to the clamping tools, as this is subjected to frequent knocks. The use of a guard over these was avoided to keep the tool as handy as possible.

The system has remained remarkably free from trouble. An early trouble was from small pieces of rubber from the flexible hose which got into the system during the hose assembly and remained inside after the preliminary flushing. These lodged in the unloading valve and blew several fuses before being cleared.



LOW-PRESSURE SYSTEM. Cut-off tools are actuated by two-position solenoid valves. Pressure switch actuates unloading valve to unload pump while sufficient pressure is stored in accumulator.

During the first week of operation, an accumulator diaphragm burst and the nitrogen was discharged rapidly down the feed line into the reservoir. The terrific surge blew a large quantity of oil out of the tank.

The system has now been in operation for 2½ years without a breakdown, and the emergency system has been used only during fuse changes in the early days of operation. ▼▼▼

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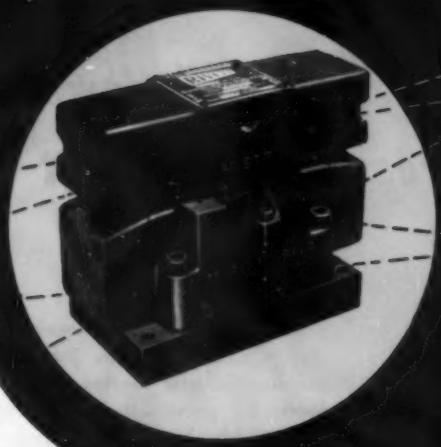
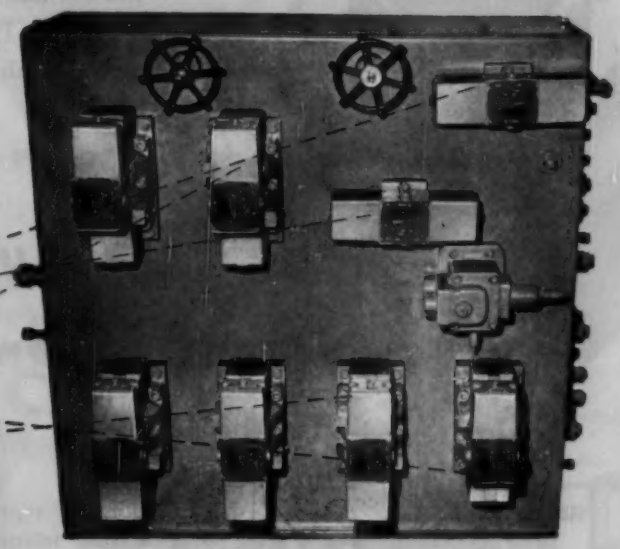
with Rivett Panel Valves





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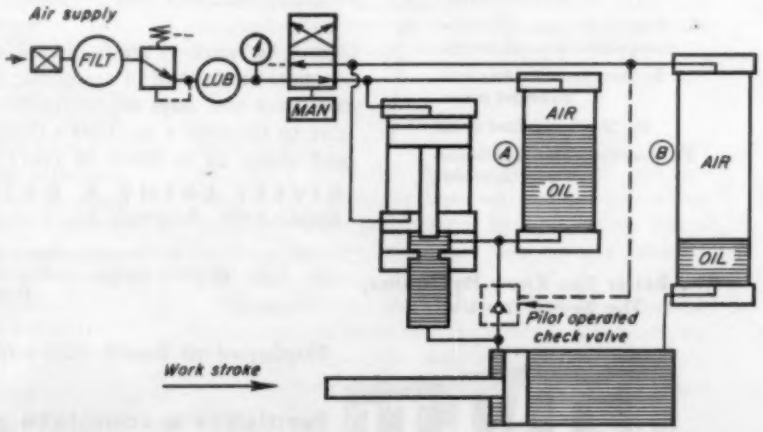
Problem Clinic

For a repair fixture, a small press was needed to pull out bushings which had been press-fitted into a housing. The work cycle is the reverse of most presses. This job calls for . . .

Initial High Pressure Followed By Low Pressure Knock-out

BECAUSE the repair fixture is used very intermittently, the design did not warrant consideration of a pump system. A hand operated arbor press which had been used required too much manual effort. From the standpoint of cost and ease of operation, the air-oil booster circuit offers an excellent power source for this job.

However, the pressure requirement for the work cycle is the reverse of the usual dual pressure circuit. On most jobs, the dual pressure circuit is arranged to supply low pressure fast approach followed by high pressure squeeze or clamp action. On this job, high pressure is first needed to break loose the press fitted bushing. Once the bushing is free, pressure must drop to prevent damage to the part. The work stroke is completed under low pressure. Since pressure is a function of work load, air pressure will first act against the booster piston to produce the "break-free" pressure on the work. When work resistance drops, air flow will take the path of least resistance to drive oil out of tank A to complete the stroke.



HIGH PRESSURE SQUEEZE is supplied by the booster. Tank A supplies low pressure oil to complete the work stroke. Tank B supplies oil to return the work cylinder.

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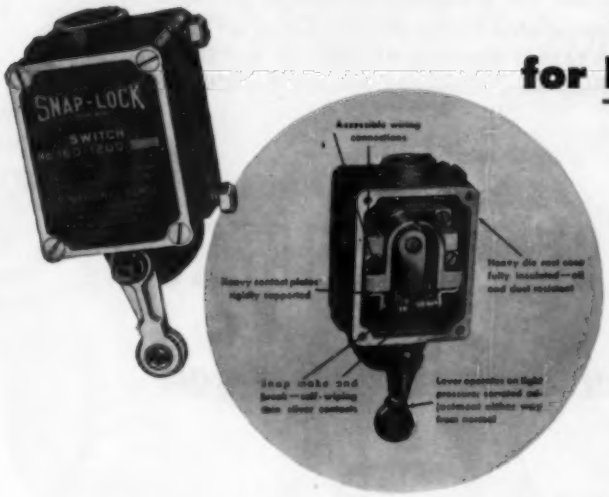

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- **Standard Models include short travel, neutral position, water resistant and hazardous location styles.**
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(Left) Electrical side (completely sealed from mechanical operating side)

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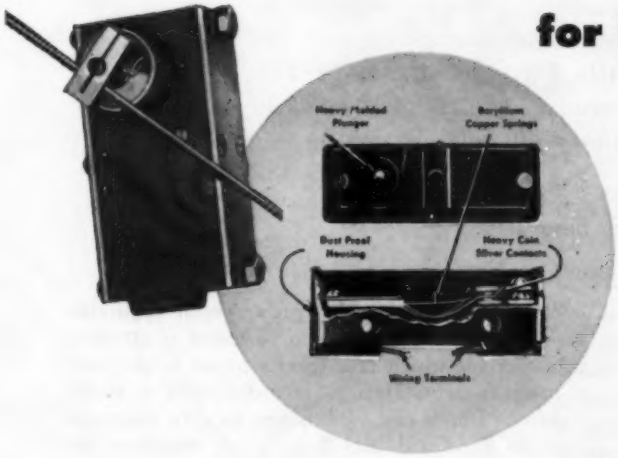

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(Left) Micro Switch in Namco protective housing.

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HYDRAULIC SHOCK ABSORBERS

. . . for aircraft landing gear

Much development work has been done on hydraulic shock absorbers for aircraft landing gear using the principle of the compressibility of liquids. Where loads are very heavy and space is limited hydraulic units have an advantage over pneumatic shock absorbers because of decreased maintenance and elimination of auxiliary air compressors.

• By A. E. Bingham

THE hydraulic shock absorber, or "liquid spring" is more than a simple spring dependent on the compression of a liquid. It also includes a dash-pot action for the absorption of energy, the fluid for the dash-pot being the same as that which is compressed. The shock absorber contains a piston with either fixed or controlled orifices. The dash-pot action depends on the square of the piston velocity and the density of the fluid. In aircraft applications the flow through the orifice is usually turbulent. All orifices are open during the compression stroke, and a restricted number are open during the recoil stroke.

ORIFICE DESIGN

Determining orifice size for development of shock absorbers is very difficult and the required design is usually determined experimentally. Performance is checked by drop testing on a special apparatus in which the landing gear to be tested is attached to a carriage which falls from a preset height with a preset weight. Data is recorded with a multichannel cathode-ray oscilloscope to give diagrams such as Figures 1 and 2 in which reactions are plotted against shock absorber travel. Figure 1 shows good performance and Figure 2 shows poor performance. The total energy absorbed by dash-pot action on compression is represented by the area under the top curve. This area divided by the area of the rectangle enclosing the curve gives the efficiency of the shock absorber. With simple orifices in a well designed unit, the efficiency is of the order of 75%. High peaks at any point in the compression curve reduce the efficiency. However an aircraft landing gear must function under widely varying conditions such as tail up, tail down, with and without drag, with and without side load, and different vertical velocities for take-off weight and

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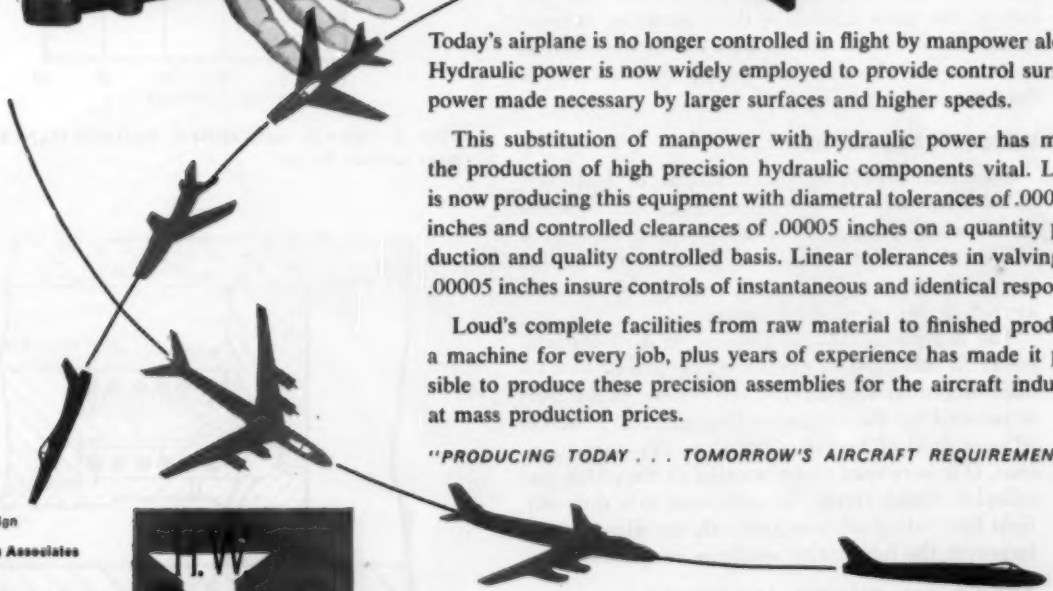

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landing weight. Therefore it may be difficult to maintain even 75% efficiency in some cases.

IMPROVING EFFICIENCY

To improve efficiency, devices such as spring-loaded valves (Figure 3) are used. These should theoretically give an efficiency of 100%, and in favorable circumstances 97% has been reached. In general practice the design objective should be not more than 90% efficiency, because the slightest vibration decreases the efficiency several per cent.

Figure 2 shows the effects of peaks due to vibration or surges. If the spring curve is too high, a peak near full closure caused by closing the spring-controlled valve can be higher than the forward peak caused by too high an opening load or poor design of the landing gear.

The spring-loaded valve may have a small integral piston immediately behind the valve face, so that the liquid jet which is discharged through the valve impinges on the piston and the resulting action helps to hold the valve open. Added to this there is a differential pressure across this small piston which also helps to hold the valve open. This piston works in a small cylinder or chamber which has an orifice connecting with the main cylinder. This orifice damps the action of the valve. The spring-loaded valve must act quickly, but it must not oscillate, because this would set up violent surges which would produce excessive stress.

The required areas of the piston and the damping orifice are difficult to calculate and have been mainly determined by experience and finally adjusted during drop testing. The higher the efficiency, the more difficult is this operation, because maximum allowable forces must not be exceeded at any time, and the absorbed energy must not be less than the minimum required.

WEIGHT REDUCTION

Two methods of reducing weight of hydraulic shock absorbers are by pre-stressing the cylinder or by using a more compressible fluid such as a silicone fluid. Pre-stressing the cylinder reduces its thickness and permits a small increase in the volumetric expansion of the cylinder.

The compressibility of silicone fluid of low viscosity is over 20% greater than petroleum-base fluid of similar viscosity, so the volume of the fluid is reduced by the corresponding amount. However silicone fluid of low viscosity is a very poor lubricant. If it were used alone, scoring of the piston and cylinder would result. To overcome this difficulty, light lubricating oil is mixed with the silicone. This improves the lubrication qualities considerably.

TENSIONAL SHOCK ABSORBERS

Occasionally shock absorbers which act in tension are required and are usually more complex

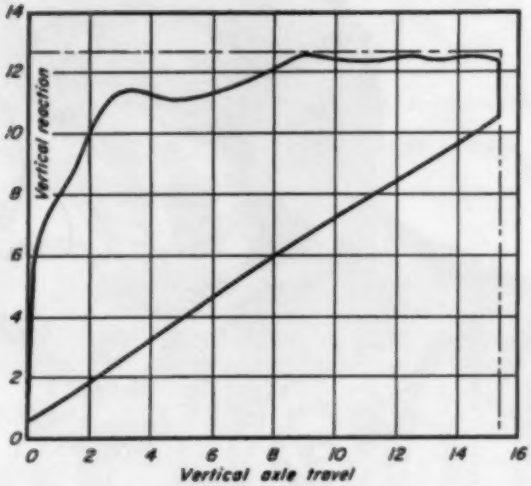

FIG. 1. SHOCK ABSORBER PERFORMANCE with good orifice design.

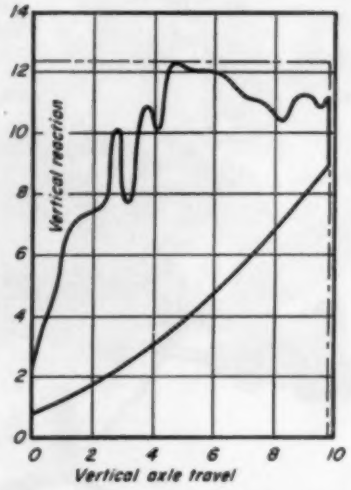

FIG. 2. SHOCK ABSORBER PERFORMANCE with poor orifice design.

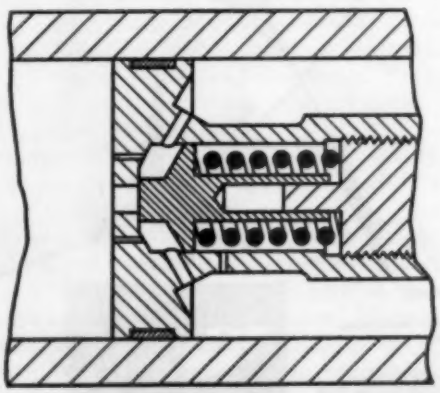

FIG. 3. SPRING-LOADED VALVE improves efficiency of shock absorber.

This small single unit has a force output of 1,700 pounds and a 3.3 inch stroke, but weighs only 3.4 pounds including the servo valve with integral pressure operated bypass.
This large tandem valve and cylinder combination has a force output of 15,000 pounds, a 9.7 inch stroke, with a weight of only 30 pounds.

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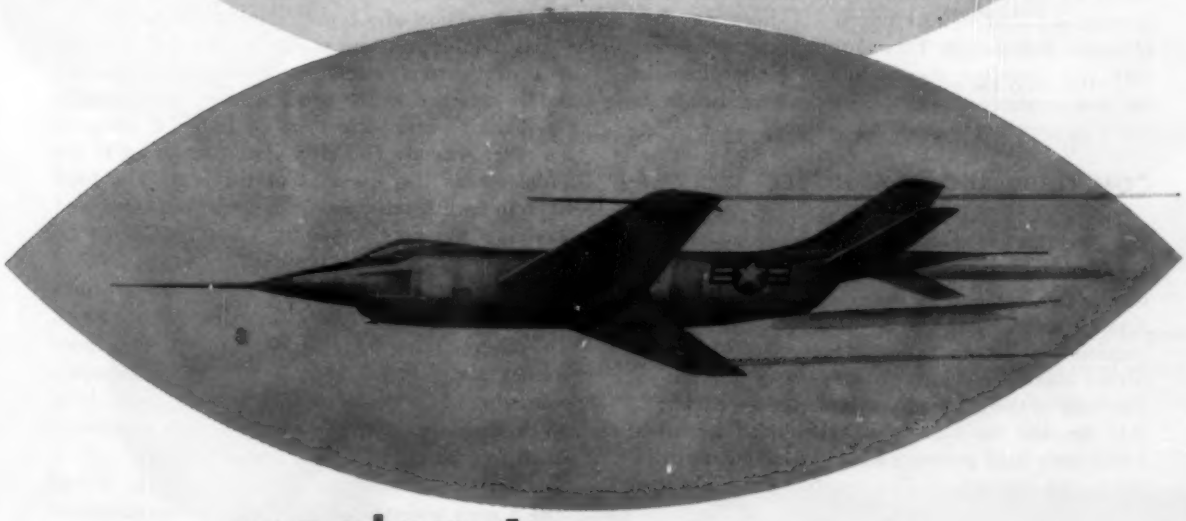

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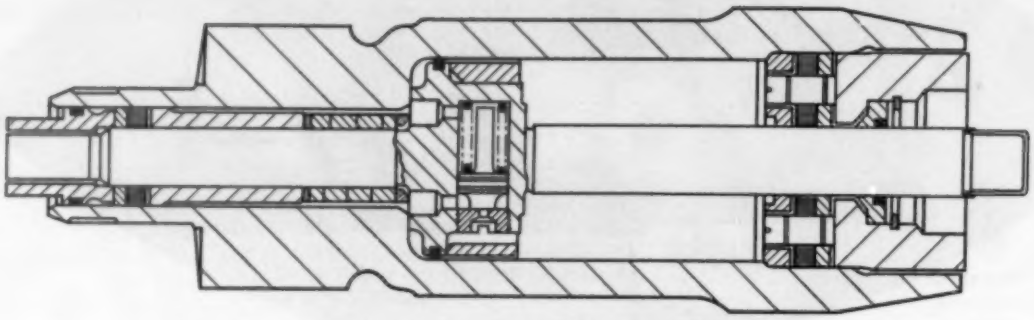


FIG. 4. TENSIONAL SHOCK ABSORBER requires two working seals.

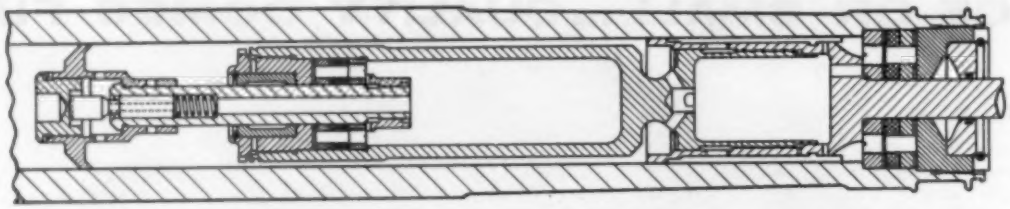


FIG. 5. COMPOUND SHOCK ABSORBER having an internal coaxial cylinder.

than those which act in compression. The piston rod must be of the differential type with the tension applied at the small end so that the larger end is pulled into the cylinder. The compression is effected by the displacement of the differential area. A cross sectional view of a tensional shock absorber is shown in Figure 4. Two working seals are necessary and therefore the friction is higher than in the compression absorber. The overall length is much greater because of the tail rod.

COMPOUND SHOCK ABSORBER

The basic curve for a simple hydraulic shock absorber is not always satisfactory for some applications. In some cases a flatter curve is required during the first part of the compression stroke and a much steeper one for the last part. This can be obtained by incorporating a secondary shock absorber inside the primary one as shown in Figure 5. The wall of the secondary cylinder is comparatively thin because the outside is surrounded by oil at moderately high pressure when the secondary cylinder comes into action. The resulting shock absorber curve is shown in Figure 6.

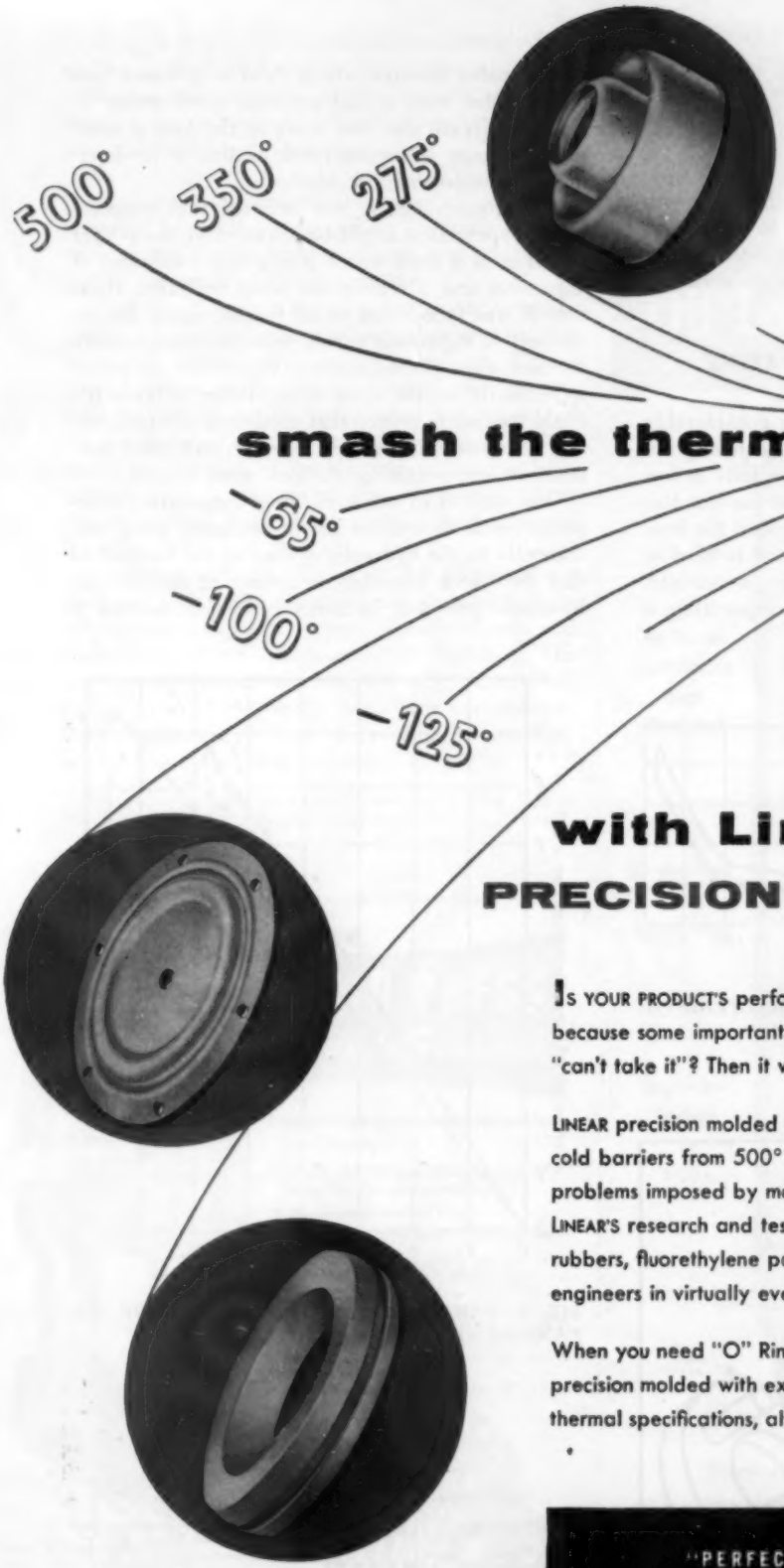
SEALS

The high pressure seals used in hydraulic shock absorbers are based on a design of unsupported area. In this type of seal the pressure on the seal is greater than the pressure of the liquid, and therefore there is no leakage. It is important that the seal be designed so that this differential pressure is optimum. If the pressure differential is too low leakage may result, if the differential is too high there will be excessive friction. Figure 7 shows the construction of a typical high pressure seal.

The liquid pressure acts over the full annular area of the seal assembly. The pegs which are rigidly attached to the inner washer pass through the seal ring and approximately half way through the outer washer. The area of the seal ring is the annular area less the area of the pegs. The total force in each axial direction must be the same, and therefore the pressure in the seal ring must be higher than that of the liquid.

To prevent extrusion of the seal, chamfer rings are provided around the piston rod and the pegs. To relieve trapped pressure between the inner washer and the seal ring, a wire mesh assembly consisting of two disks of wire mesh at an angle of 45 degrees is inserted to provide a large number of small free passages for the trapped liquid.

Materials and fits are very critical for a seal which must withstand a large number of operations under extreme conditions. The seal material which has proven most acceptable is fabric-reinforced synthetic rubber used with mineral oils. The inner washer and pegs are of high-tensile steel, and the outer washer and chamfer rings are aluminum-bronze.



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This type of seal has been used in service with pressures up to 55,000 psi although the maximum working pressure is generally limited to 50,000 psi for long life of the seal. Under test conditions the seal has been used with pressures as high as 85,000 psi.

PRESSURIZATION AND TEMPERATURE COMPENSATION

Although performance may not be considerably affected by temperature change, it is frequently important that the shock absorber extend fully at low temperature. If the temperature is not too low this can be accomplished by filling the unit at the lowest temperature required. When the unit is filled at some higher temperature, it should be pressurized.

Pressurization is achieved by incorporating a special valve through which fluid is pumped into the cylinder with a high-pressure hand pump or standard grease gun. For work in the field a small pressure gage is incorporated so that a predetermined pressure may be applied.

A few years ago it was believed that temperature compensation might be achieved by the proper selection of a fluid which had a low coefficient of expansion and a reasonable compressibility. However it was found that in all liquids tested the coefficient of expansion varied with the compressibility, and when plotted against one another all points were nearly on the same straight line (Figure 8). Fluid specialists proved that coefficient of expansion and compressibility varied together, and other temperature compensating devices were sought.

One method of accomplishing temperature compensation is to connect the pressurizing valve permanently to the hydraulic system of the aircraft so that the shock absorber is always at the aircraft hydraulic pressure. In many cases this method is

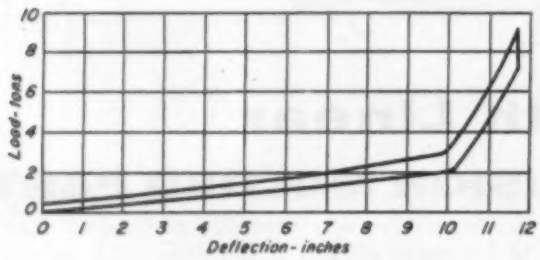

FIG. 6. LOAD DEFLECTION CHARACTERISTIC CURVE for compound shock absorber.

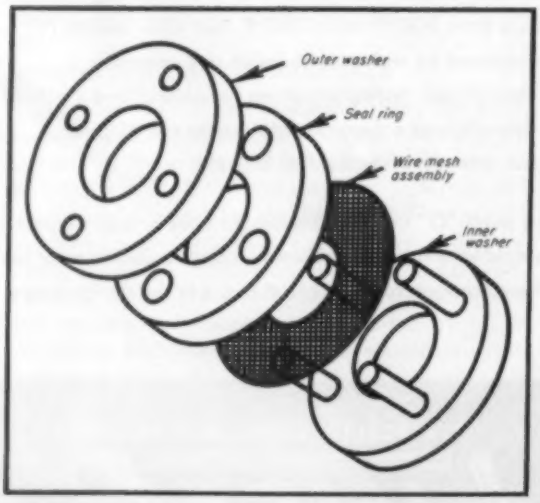

FIG. 7. HIGH PRESSURE SEAL in which pressure on the seal is greater than pressure of the liquid.

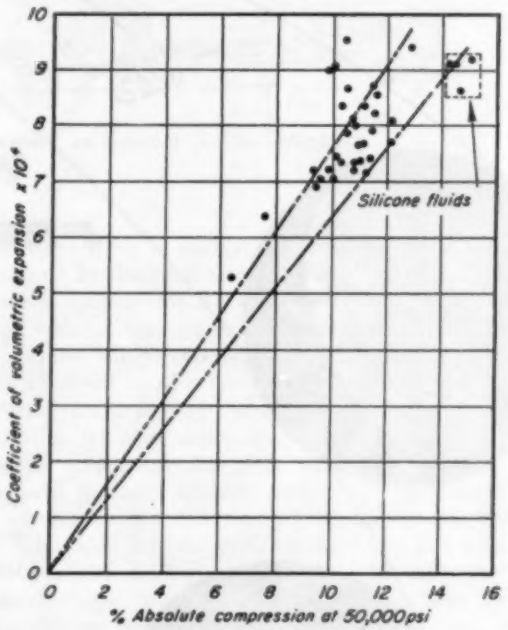

FIG. 8. VARIATION OF COEFFICIENT OF EXPANSION with compressibility.

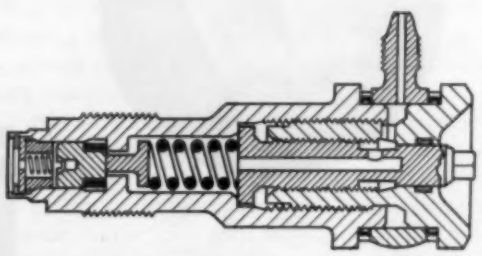

FIG. 9. LEAKAGE VALVE is used on shock absorber energized from aircraft hydraulic system.

highly effective and the shock absorber extends fully under no load. However in high-performance aircraft this pressurization may take place at a low temperature and a landing under warmer conditions may produce bumpy taxiing.

To overcome this, a leakage valve (Figure 9) has been added to the pressurizing valve to permit the unloaded pressure in the shock absorber to leak away slowly until a pressure is reached just above that in the main hydraulic system.

The rate of leakage is critical when the pressure rise in the shock absorber is very slow as when the aircraft is lowered after being jacked up. During this operation if the rate of leakage were greater than the rate of oil displacement of the piston rod the displaced oil volume would be lost and the unit would be damaged. In some instances this has been prevented by having an overriding control which closes the valve while the aircraft is being lowered from the jacks.

A large percentage of aircraft landing gear are equipped with hydraulic shock absorbers with their advantages of ruggedness, ease of maintenance, and elimination of air compressors for inflation. The smallest unit has a maximum load of less than 1 ton and a stroke of less than 1 inch. Wide variations in loads and strokes are possible to cover the vast number of shock absorber problems. ▼▼▼

This article is based on a paper presented in May 1955 *to The Institution of Mechanical Engineers, London, England.*

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PILOT-OPERATED CIRCUIT

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• By G. F. Day

THERE are several ways of obtaining reciprocating motion with a cylinder controlled by a 4-way valve. If the valve is solenoid-controlled, several arrangements of piston-actuated limit switches can be used. However, at Durez Plastics the equipment must operate in an atmosphere of plastic dust. Electrical equipment would be a hazard unless explosion-proof equipment were selected at increased cost. Consequently a pilot-operated 4-way valve is used to ensure safe operation at minimum cost.

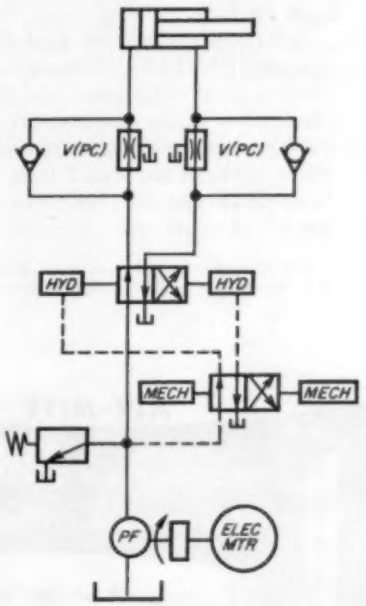
Dogs Initiate Reversal

A mechanically-actuated 4-way valve controlling pilot pressure to the pilot-operated valve is fitted with two dogs and is operated by an arm on the driving cylinder. When the cylinder is fully extended, the pilot valve reverses and positions the pilot-operated valve to retract the cylinder.

Variable-orifice, pressure-compensated flow control valves are included in the line to each port of the cylinder to provide a meter-out speed control in both directions. The flow control valves are alternately bypassed by the parallel-piped check valves.

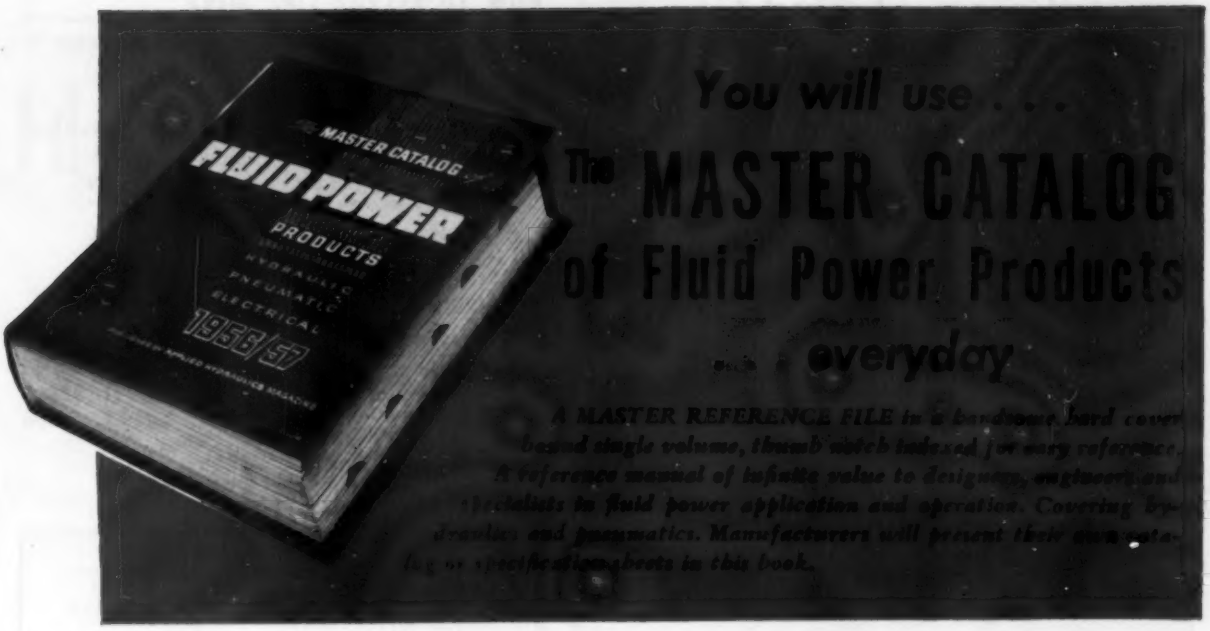
System pressure is 350 psi, and the pump is rated at 40 gpm, 1200 rpm, 15 hp. The driving cylinder has a 4-inch bore and a 12-inch stroke developing 4400 lb thrust at 350 psi. The pressure-compensated flow control valves are adjustable for a maximum flow of 20 gpm which produces thirty 12-inch strokes per minute. The foot-mounted pilot valve has a maximum capacity of 3 gpm.

In order to prevent foaming because of the frequent reversals, the pilot-operated valve was selected with ¾-inch ports. At the maximum flow of 20 gpm, this gives a flow velocity of 15 ft/sec through the ¾-inch pipe to the cylinder. ▼▼▼



SIMPLE CIRCUIT is used to automatically reverse hydraulic cylinder motion. The pump must be stopped to stop motion at a point between the ends of the stroke.

G. F. DAY, *Durez Plastics Division of Hooker Electro Chemical Co., N. Tonawanda, N. Y.*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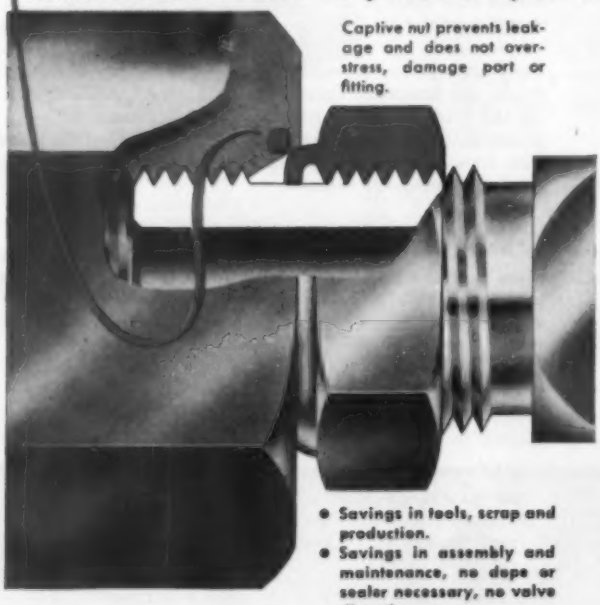

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HOW TO SELECT LINE SIZES

Concluded from page 42

The Reynolds number is less than 2000 indicating laminar flow. Now using formula (6):

$$P = \frac{5.17 \times (50 + 10 + 10) \times 10^2 \times .90}{1530}$$

$$= 21.3 \text{ psi}$$

WALL THICKNESS

When the inside diameter of the fluid line has been determined, the wall thickness can be specified on the basis of system pressure. Table III shows recommended pipe sizes for pressures of 1000 psi and

TABLE V

Two wire braid hose size		Maximum working pressure (psi)	Minimum bend radius (in)
ID (in)	OD (in)		
3/16	5/8	6,000	4
1/4	11/16	5,000	4
3/8	7/8	4,000	5
1/2	1	3,500	6 1/2
3/4	1 5/16	2,750	9 1/2
1	1 9/16	2,000	11
1 1/4	2	2,000	16
1 1/2	2 1/4	1,500	20
Single wire braid hose size		**Maximum working pressure (psi)**	**Minimum bend radius (in)**
ID (in)	OD (in)		
3/16	1/2	2,500	4
1/4	5/8	2,000	4
3/8	3/4	1,750	5
1/2	15/16	1,500	6 1/2
3/4	1 1/4	1,250	9 1/2
1	1 1/2	800	11
1 1/4	1 13/16	500	16
1 1/2	2 1/16	400	20

TABLE V Pressure ratings for two wire braid and single wire braid hose.

3000 psi. For tubing, wall thickness can be selected from manufacturer's data such as shown in Table IV. Table V shows typical pressure ratings of flexible hose. In selecting flexible hose, the pressure rating is determined by the fabric or wire braid reinforcement. Hose is proof tested by the manufacturer at twice the working pressure and has a burst pressure of 4 times the working pressure. JIC standards state that above 150 psi, flexible hose shall have a safety factor of 5 to 1 with respect to the circuit in which it is used. Suction hose is reinforced with one ply of cotton fabric and has a spirally wound spring steel wire under the outer covering.

Although the above considerations are the primary ones in selecting fluid line sizes, sometimes other factors such as vibration, mechanical loads on the lines, and exposure to abuse must be taken into account. Occasionally these determine that the line must be heavier than computed. ▼▼▼

Ideas from a Sales Engineer

Elmer F. Heiser

During Elmer Heiser's 18 years of selling air and hydraulic components, he has solved many problems and has left some unsolved. He is the author of the recently published book "*Air and Oil Cylinders in Industrial Applications*". Because we enjoy learning of Elmer's experiences and opinions, we've asked him to write these monthly columns. We hope you too are finding these columns amusing, interesting and informative.

What's the life of the equipment?

FREQUENTLY, when we work with someone on the first hydraulic installation in a plant, we are asked how long they can expect it to operate. This is a reasonable question.

The hydraulic arrangement may appear quite simple compared to a mechanical means to accomplish the same purpose, but apparent simplicity is not enough. A man who is not familiar with hydraulic pumps, valves, cylinders, etc. would have no way to determine the expected life of such equipment.

"How long will it run before trouble develops, and if it does, what will probably fail first?" This is a hard question to answer because so many factors are involved. It calls to mind a joker in one plant who spent a good deal of time covering his tracks, figuring ways to keep himself out of trouble. One device was to be evasive and completely noncommittal, whenever a specific answer was required. If he was asked, "How long can we expect this equipment to run", he would counter with an old standby question of his own: "How long is a piece of string?" This was never a very satisfactory answer but he always figured that if you wouldn't answer his, why should he stick his neck out on an answer to yours.

There are some jobs where the duty cycle is so relatively mild and other conditions so favorable, we can recklessly set a time before any failure might be expected. However, on the average installation, where equipment is in regular operation through one, two, or three shifts per day, wear out or failure time is harder to predict. What factors influence the life of hydraulic equipment? Probably the most important are service duty and the quality of maintenance. For comparison consider automobiles; one driver will run the guts out and the wheels off in 15,000 miles while another can get an easy 50,000 miles from the same type car without excessive wear or break down.

Another factor in equipment life may be the unpredictable one called coincidence. For some un-

BOURNS
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GAGE PRESSURE
POTENTIOMETERS
For
Precise
Pressure
Reporting...
INDICATING—
RECORDING—
CONTROL
Designed for measuring pressure in aircraft, guided missiles and other equipment, BOURNS Gage Pressure Potentiometers are available in ranges from 0-100 psi to 0-5,000 psi. Actuated by the flexure of a Bourdon tube, these precision instruments have an electrical output which is linear with the applied pressure. Resolution of 0.4% and power of ⅛ watt are obtainable in a wide variety of resistances.
Though miniature in size and light in weight, BOURNS Gage Pressure Potentiometers are extremely rugged and accurate. A ball bearing supported linkage system transmits the movement of the Bourdon tube to the sliding contact. Instruments are not damaged by shock, vibration or nominal over-pressure.
BOURNS designs and manufactures other precision potentiometers for measuring position, differential pressure, absolute pressure, altitude and acceleration.
BOURNS is also, the creator and exclusive manufacturer of the TRIMPOT
BOURNS LABORATORIES
6135 Magnolia Avenue,
Riverside, California
Technical Bulletin on request, Dept. 293

Circle 17 on Reader Service Card 77

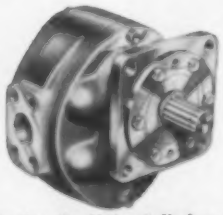
Every Day is Moving Day in a Strip Mill and a Load May Weigh 50 TONS!

The YALE Giant Ram, handling loads to 50 tons, is the practical answer to smooth, speedy movement of the heavy rolls. Hydraulic controls for operation are HYDRECO!

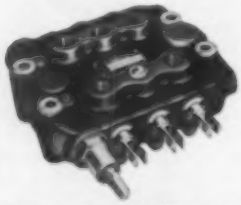
But, It's Up and Away With a Flip of a Valve

with

HYDRECO Oil Power



Power for the Hoist Cylinder and adjustable forks of the YALE Giant Ram is furnished by a 3000 Series HYDRECO Pump.



Series V-12 HYDRECO Valve controls the Hoist Cylinder. An auxiliary HYDRECO Valve controls the forks.

The equipment that is "getting things done" today is more often than not equipped with HYDRECO Hydraulic Pumps, Motors, Valves and Cylinders. And, in engineering tomorrow's successful Materials Handling equipment, Farm Machinery, Heavy Construction and Earth Moving vehicles, the one outstanding attribute you will look for in components for the hydraulic system is —DEPENDABILITY. For years, the builders of equipment that "sells and performs" have used HYDRECO Oil Power. And, they have also drawn freely from the well of engineering "know-how" and experience which is here in HYDRECO. All are here for you, too.

WRITE— for full information on new developments in HYDRECO Oil Power.

HYDRECO DIVISION

THE NEW YORK AIR BRAKE COMPANY

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INTERNATIONAL SALES OFFICE, 90 WEST ST., NEW YORK 6, N. Y.

Ideas from a Sales Engineer

Continued

explainable reason something may happen to upset any reasonable life expectancy prediction. Even with automobiles, ninety-nine will run fine while No. 100 for some fool reason persists in acting up.

It can generally be stated that hydraulic pumps are very dependable. We are acquainted with one installation, which under adverse conditions, perked along in good shape for fourteen years. Never having experienced trouble, no one knew what to expect or what to do when it finally kicked over the traces.

This brings up another point. What about spares and standby equipment. As mentioned, hydraulic systems may perform so well for so long they are practically forgotten. When one of these old reliables folds up it too often causes a sudden realization of its importance in the scheme of things. Then even the best delivery on a replacement unit is not good enough. When one little old pump becomes the key in a vital operation it would seem that its importance would be recognized in advance.

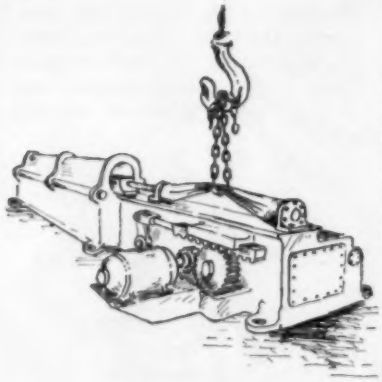
If the time required for delivery of a replacement pump will put a kink in the process or the profits, several alternative precautions may be taken in advance to avoid or shorten downtime. The most obvious would be to carry a replacement pump in stock. Of course, if the original one crosses you up and runs for fourteen years, you will have two obsolete pumps on hand. It is necessary to weigh the cost of a replacement, which may not be needed, against the cost of a shut down without it.

On an extremely critical operation, where any down time can be serious, a complete standby system, ready to kick in, may be advisable. Again the initial cost of the duplicate system must be weighed against the cost of a possible failure of a single unit.

Sometimes two pumps, each doing half the work, may be better than one. On some applications,

where half-speed is better than none it makes sense to use two pumps, each with one half the total required capacity. If one fails the other can keep things moving until repairs are made.

Once while working on a steering gear for tugs we had occasion to become concerned about standby hydraulic equipment. A tug may have five million dollars worth of ship in tow, snaking through a narrow channel where some more millions in bridges, docks, and other ships can get mixed in. Sudden loss of full steering speed and power would seem to invite possible catastrophe, therefore we suggested a complete standby hydraulic unit with an automatic kick-in in case of fail-



"Where'd we buy that rotten cylinder?"

ure. A reasonable reply to the suggestion was advanced. It seems there are a number of critical components which make up the machinery crowded into a modern tug. Not the least of these is the main engine. "Would we suggest that a tug be made twice its normal size to accommodate two of each critical item". That's a good answer. Besides when these vessels regularly operate on twenty-four hour duty through numerous shipping seasons without any hydraulic steering failure a spare unit seems like excess baggage.

What about spares and standbys and what conditions warrant them? Well, its like this—on second thought, how long is a piece of string? ▼▼▼

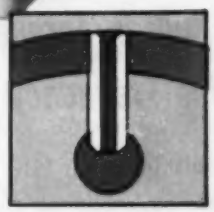
Next Month: Automation

... more than double the life of your hydraulic system ... at no additional cost.

Today's production lines cannot afford avoidable machine breakdowns. DUDCO PF-100 Pumps, rated at 2000 psi for continuous operation, provide the extra margin of operating safety which your customers need so badly. The hydraulic system may not require more than 1000 psi – but the extra stamina provided by a 2000 psi DUDCO Pump cuts downtime AND more than doubles the life and dependability of the hydraulic system.

This added safety factor makes sense and saves dollars for the user ... and at the business end of a sale, can make the deciding difference. You pay no premium for DUDCO 2000 psi continuous operation. They cost no more than pumps rated at considerably lower pressures. There's a DUDCO PF-100 Pump in a size and capacity and mountings to fit nearly all standard machine tools.

Users of machine tools can modernize and improve the dependability of their equipment with DUDCO PF-100 Pumps.



TWO VANES ARE BETTER THAN ONE

The hydraulically counter-balanced DUAL-VANES in DUDCO Hydraulic Pumps eliminate wear producing loads normally caused by unbalanced hydraulic forces and vane acceleration. DUAL-VANES also maintain MULTIPLE SEALING BARRIERS to slippage and power loss. DUAL-VANES are a patented and exclusive DUDCO feature.

Get the facts on the Dudco PF-100 Dual-Vane Pumps and Fluid Motors. Write today.

DUDCO DIVISION
THE NEW YORK AIR BRAKE COMPANY
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INTERNATIONAL SALES OFFICE, 90 WEST ST., NEW YORK 6, N. Y.

New! SANDERS "MINIVALVE"

MODEL SA-14

Compact
Lightweight
Non-Jamming
Low Input Power
Built-in Torque Motor
Wide Frequency Response

This miniature valve is an advanced design of a 2-stage hydraulic amplifier utilizing the "Bootstrap" principle to develop larger forces with low input power requirements. Its improved, self-clearing feature eliminates jamming.

SPECIFICATIONS:
Flow — 4 GPM for 1000 PSI drop across valve, System Pressure — 3000 PSI; Frequency Response — 100 cps. (Also available: "Minivalves" with flows up to 200 GPM.) Size — 1" x 1" x 3⅝"

For detailed specifications, write to Dept. A

SANDERS ASSOCIATES INCORPORATED
NASHUA NEW HAMPSHIRE

New Products continued

SHAFT SEAL
. . . for use to 150 psi

Designation: BB-21A Mechanipak

Construction: Standard construction includes brass shell, brass washer, and Buna-N bellows. Buna-N or neoprene bellows furnished for operating temperatures up to 212 degrees F and pressuers to 150

psi. Silicone bellows are provided for temperatures to 400 degrees F where pressures do not exceed 50 psi.

Features: For shaft speeds to 2000 ft/min and higher depending upon operating conditions. Seals are available in sizes for shafts from ⅜ to 3-inch diameter. Units are designed to eliminate wear on shafts and shaft sleeves, eliminate fluid leakage, reduce down time, and cut maintenance costs.

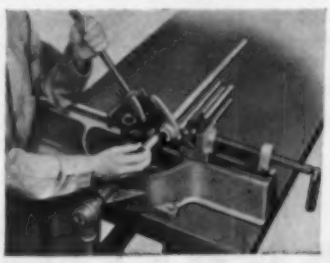
Garlock Packing Co.
Palmyra, N. Y.

Circle 116 on Reader Service Card

TUBE BENDER
. . . has new toggle clamp

Designation: Model 824

Features: Tube bender now includes a toggle clamp for easier and



speedier operation. Toggle clamp saves time by providing quicker gripping of the tube to be bent. The clamp is attached by inserting its swivel block into a hole of the bender radius block. Toggle clamp accommodates tubing of 1½-in. OD. Shoe inserts are available for tubing from ⅜ through 1¼-in. OD.

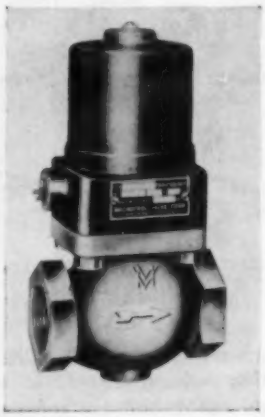
Tube & Hose Fitting Div.
Parker Appliance Co.
Cleveland, Ohio

Circle 117 on Reader Service Card

SOLENOID VALVE
. . . for higher temperature, pressure

Designation: Type S

Design: Valve utilizes line pressure to assist the solenoid in opening and closing. An auxiliary operating piston, that is integral with the disc holder, assists the solenoid



in opening the valve against higher line pressures. At low or no pressure the solenoid alone will actuate the valve. The pilot valve is stainless steel and the valve is single-seater and closed by a resilient disc for higher temperature service to 400°F.

Features: The entire solenoid and operating mechanism may be removed and serviced without breaking the electrical leads or removing the valve body from the line. Valve can be supplied with either hand lift or hand lever for manual control; or with metering stem for throttling the flow.

Magnatrol Valve Corp.
Hawthorne, N. J.

Circle 118 on Reader Service Card

Continued on page 82

Wherever throw-off, drip or squeeze-out is a problem...

USE SUNTAC OIL

OIL LEAKAGE MEANS:
higher lubrication costs
messy machines
hazardous oil slicks on the floor

SUNTAC OIL:
cuts leakage
lowers oil costs
minimizes hazardous floor conditions

In addition to its leak reducing properties, Suntac has all the high quality of expensive general-purpose oils. Suntac is fortified against oxidation to assure long oil life and against rust and corrosion to protect valuable machines. And, last but not least, because the leak-reducing agent is 100% petroleum, Suntac leaves no gummy film or residue.

For more information about Suntac, the oil especially made to prevent drip, throw-off and squeeze-out, see your Sun representative or write for your copy of Suntac Technical Bulletin to Sun Oil Company, Philadelphia 3, Pa. Dept. AH-8.

SUNOCO®

INDUSTRIAL PRODUCTS DEPARTMENT

SUN OIL COMPANY

Philadelphia 3, Pa.

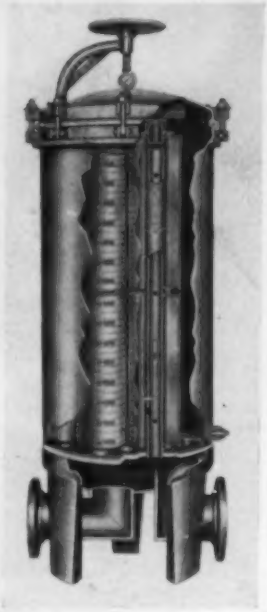
IN CANADA: SUN OIL COMPANY, LTD., TORONTO AND MONTREAL

New Products / continued

OIL FILTERS
. . . 25 to 900 gpm

Design: Extra large dirt-holding capacity is obtained by new cartridge designed for this filter. Resin-impregnated, pleated-paper cartridge has 44 sq. ft. of filtering surface. Filter element in cartridge is completely inert and will not remove additives in oil. It will not soften or disintegrate when used on liquids having a water base.

Features: Models feature quick opening covers for convenience in changing cartridges. Covers are fastened by swing bolts for removal by one man. Large models have unique lifting device that swings cover to one side for easy access to



cartridge. None different sizes are available using 1 to 36 cartridges. Pressure drop across unit is 4 psi with oil of 170 SUS operating viscosity.

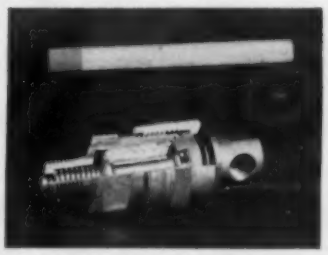
Houdaille-Hershey of Indiana, Inc.
Lebanon, Indiana

Circle 119 on Reader Service Card

ROTATING SWIVEL
. . . for high pressure

Designation: Model 4000

Design: Built for high pressure and high operating speeds, the swivel is equipped with spring-loaded Teflon rings, self-centering



ball-thrust bearings, and highly efficient axial bearings. Designed particularly for brakes and clutch applications, the unit is compact measuring only 3 x 1½ inches and is especially suited for use in close quarters.

Hydraulic Unit Specialties Co.
Waukesha, Wisconsin

Circle 120 on Reader Service Card

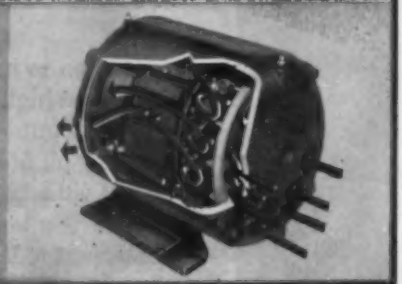
Continued on page 84

To HYDRAULIC ENGINEERS, Howell suggests

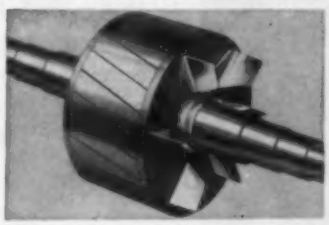
What to look for in Part-Winding Motors

If you've investigated reduced voltage starting of centrifugal pumps, compressors, etc. with part winding (synchronous) motors, you know of the economies and efficiency to be gained.* But, as in other types of motors, manufacturers' constructions differ considerably. Below are some points for comparison . . . and a few of many reasons why Howell motors are so outstanding!

VENTILATION . . . "Cool running" means long life in motors. The steel shell of a Howell motor and a new stator design with the largest air passages yet devised put ample ventilation where it's needed. Compare!



BEARINGS . . . They should be fully protected. Dirt can't enter Howell's double shielded bearings either from inside or outside the motor, because they are sealed in the end plate cavities by dust-tight inner caps. Compare!



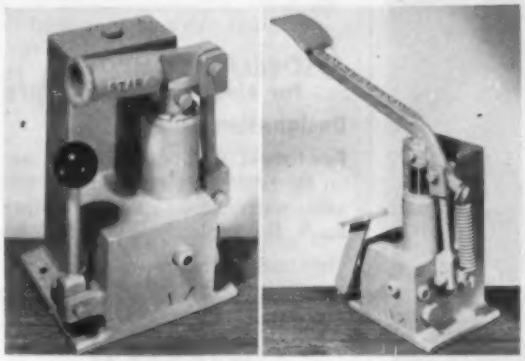
COPPER-CLAD ROTORS . . . Howell motors have copper-wound rotors. This means better heat conductivity, stability at high temperatures and, as opposed to die-cast rotors, greater design flexibility to meet your special requirements. Compare!

HOWELL MOTORS

HOWELL

Circle 86 on Reader Service Card

STAR Hi-Lo TWO SPEED CONCENTRIC PUMPS



- **HAND OR FOOT OPERATED WITH SINGLE LEVER OR PEDAL**

  Two speed construction provides automatic change-over during operating cycle from high speed low pressure to low speed high pressure.

- **MAXIMUM CAPACITY 10,000 P.S.I.**

  Safety overload valves—Hard chrome plated pistons—Piston stroke 1½ inch—Oil capacity 150 cu in or larger —3 models (½"-⅞") (½"-1¼") (½"-1½")

Representative areas available

Star Jack Co., Inc.

420 Lexington Ave., New York 17

PLANT: RIVER GROVE, ILLINOIS

"John Crane" *Plastic Lead Seal is the most economical all-purpose sealing compound for pipe joints, studs and gaskets—*because you use less to get a better seal.* PLS seals for the life of the connection, yet never hardens, allowing joints to be easily broken after years of service.

PLS prevents galling . . . is insoluble in water, gas, steam, many chemicals and all petroleum products. Use it for all services . . . low or high pressure applications up to 6000 psi. . . . temperatures to 500°F. Carries the Underwriters' seal of approval.

Prove to yourself that it takes less PLS to give a perfect seal. Send for a generous free sample. Crane Packing Company, 1805 Cuyler Avenue, Chicago 13, Illinois.

JOHN CRANE CRANE PACKING COMPANY

In Canada: Crane Packing Co., Ltd., 617 Parkdale Ave., N., Hamilton, Ont.

You get AIRCRAFT QUALITY

To preserve their quality and shape, and permit easy installation, 50 Fluoroflex-T spiral rings come snugly seated on supporting mandrel, secured with rubber rings at each end, and in a "telescopic" container.

Millions in use verify high performance

Fluoroflex-T anti extrusion rings are produced from virgin Teflon® powder under a strict quality control and inspection system approved by the USAF under MIL-Q-5923. Millions of them are today contributing to more reliable functioning of "0" ring seals in both commercial and military aircraft hydraulic systems.

Fluoroflex-T is processed so as to relieve internal stress without creating porosity. This means maximum dimensional stability and tensile strength . . . which in turn assure optimum performance and service life.

With properties conforming to AMS-3651, Fluoroflex-T rings reduce friction, are entirely unaffected by any hydraulic fluid both physically and chemically, and withstand up to 500°F, depending upon operating pressures.

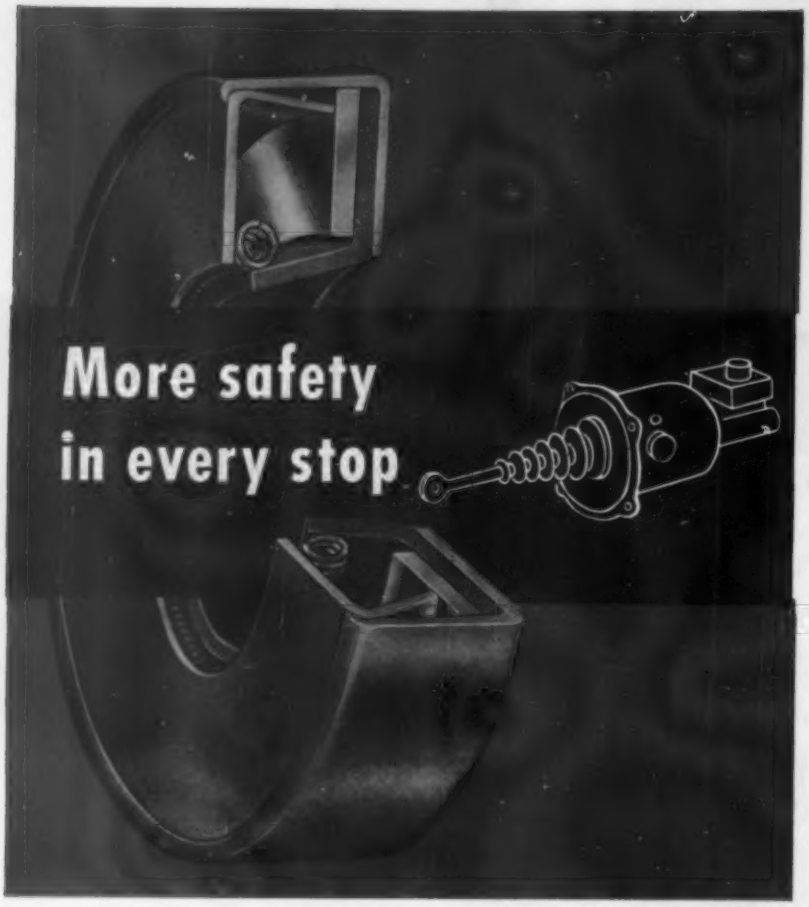
Complete range of sizes available for use with AN6227 and AN6230 series "0" rings. Send for data.

®Fluoroflex is a Resistoflex registered trade mark for products from fluorocarbon resins. Teflon is the DuPont registered trade mark for its tetrafluoroethylene resin.

RESISTOFLEX

CORPORATION

Belleville 9, N. J. • Western Division: Burbank, Calif.



C/R SEAL BACKS UP EXTRA BRAKING POWER

Every time you touch your pedal it must function dependably. In a well-known power brake unit a small C/R Oil Seal is doing a big job between the vacuum and hydraulic cylinders. It seals effectively on both sides, withstands pressures to 10 psi, and provides maximum flexibility to follow possible eccentricity up to .025". And there has never been a failure in the field. If your product must conform to equally high standards, consider C/R Oil Seals. For basic information let us send you a copy of "C/R Perfect Oil Seals."

C/R PERFECT Oil Seals

More automobiles, farm equipment and industrial machines rely on C/R Oil Seals than on any similar sealing device.

CHICAGO RAWHIDE MANUFACTURING COMPANY

1301 Elston Avenue OIL SEAL DIVISION **Chicago 22, Illinois**

IN CANADA: SUPER OIL SEAL MFG. CO., LTD., HAMILTON, ONTARIO

Other **C/R** *products*

SIRVENE (Synthetic rubber) diaphragms, boots, gaskets and similar parts for critical operating conditions • CONPOR: Controlled porosity mechanical leather packings and other sealing products • SIRVIS: Mechanical leather boots, gaskets, packings and related products.

New Products / continued

ABSORBENT COMPOUND . . . for cleanliness and safety

Designation: Hi-Dri

Features: Compound is for use on floors to absorb oils, grease, solvent, water, acids, and many other fluids. It completely eliminates slip-

pery surfaces, minimizing the hazard of accidental falling. Compound is completely fire proof and approved by Underwriters Laboratories. Natural color of the material makes it easy to see tools and other objects on the floor. Spread by hand or scoop on the soiled floor it quickly absorbs any moisture and can be easily swept up with a broom even when fully saturated. It is effective on all types of flooring and does not readily pulverize, break down or cake under heavy traffic.

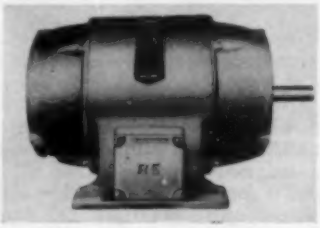
Waverly Petroleum Products Co. Philadelphia, Pa.

Circle 121 on Reader Service Card

ELECTRIC MOTORS . . . Permit combining units

Designation: XPANDABLE

Features: Design permits many unique single-frame combinations



of motors, brakes, fluid couplings and gear reducers. System saves costs over buying and aligning separate units in tandem. Combinations are achieved through the use of standard, interchangeable assemblies and result in space-saving power

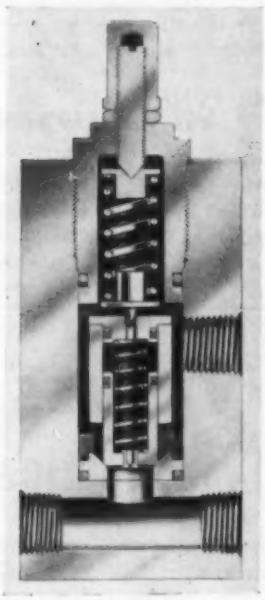
packages, tailored to the job. Alignment problems are eliminated and installation time is reduced with single package mounting. Units are available in many single-frame combinations with different mechanical and electrical characteristics with ratings from ½ through 15 hp.

Reuland Electric Co.
Alhambra, California

Circle 122 on Reader Service Card

RELIEF VALVE
. . . pilot operated

Features: New piston-type, pilot operated relief valve maintains pressure in hydraulic systems between 50 and 4000 psi. Although the body has in-line ports, the plugging of one of them permits angle installation.



Specifications: Valves are available with female pipe connections in sizes from ¼ to 2 inches in aluminum alloy or 50,000 tensile semi-steel. Three pressure ranges are 50 to 1000 psi, 1000 to 2500 psi, and 2500 to 4000 psi. Accurate adjustments may be made within each range.

Republic Manufacturing Co.
Cleveland, Ohio

Circle 123 on Reader Service Card

LIMIT SWITCH
. . . is hermetically sealed

Design: Roller actuator arm has optional settings throughout 360 degrees with operating travel of 90 degrees. The long overtravel of 81

Continued on next page

Boot for 24 feet

ADDS MILES OF LIFE TO A BIG LIFT

It's a lot of boot . . . 36-inch outside diameter and extended length of 24 feet. Designed and built by Chicago Rawhide, this boot protects the main plunger . . . saves downtime . . . on the scrap hoist in an open hearth mill. Made of synthetic rubber coated fabric, it effectively excludes dirt, and all foreign matter . . . prevents scoring and abrasion on this giant ram. Design of this boot permits quick, easy installation . . . without dismantling the hoist.

Big . . . or little . . . if your boot problem involves reciprocating, eccentric or universal action, let C/R Sirvis engineers solve it. We manufacture boots of Sirvis mechanical leather and plain or coated fabrics for every type of dirt exclusion and lubricant retention application. Please write for detailed information.

C/R SIRVIS MECHANICAL LEATHER PRODUCTS

CHICAGO RAWHIDE MANUFACTURING COMPANY

1301 Elston Avenue SIRVIS DIVISION **Chicago 22, Illinois**

IN CANADA: DISTRIBUTED BY SUPER OIL SEAL MFG. CO., LTD., HAMILTON, ONTARIO
EXPORT SALES: GEON INTERNATIONAL CORP., GREAT NECK, NEW YORK

Other C/R products

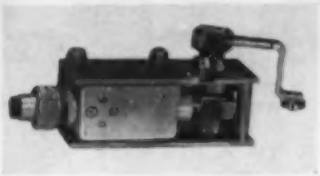
OIL SEALS: Shaft and end face seals for all types of lubricant retention and dirt exclusion • SIRVENE: (Synthetic rubber) diaphragms, boots, gaskets, and similar parts for critical operating conditions • CONPOR: Controlled porosity mechanical leather packings and other sealing products.

Circle 72 on Reader Service Card

Quality
HYDRAULIC
PACKINGS
NEOPRENE-FABRIC
COMPOUND
&
HOMOGENEOUS
"V" CUPS
"U" FLANGE
"O" RINGS
Periflex Inc.
HAZEL PARK • MICHIGAN

New Products continued

degrees protects the basic switch and also permits flexibility of operation. Hermetically sealed switch is not affected by temperature, cycling, moisture, extreme heat or cold,



dust, dirt or other foreign elements. Pretravel and movement differential can be set within 2 degrees.

Specifications: Life span of switch is 200,000 cycles. Unit is rated for 10 amps at 125/250 volts a. c. or 28 volts d. c. Ambient temperature range is —100 to 250°F. Weight is .06 lb.

Electro-Snap Switch & Mfg. Co.
Chicago, Illinois
Circle 124 on Reader Service Card

AIR HOSE
. . . rayon reinforced

Designation: Specialaire

Features: Hose is applicable to aircraft, industrial, and mobile equipment for pressures to 200 psi. Two braids of rayon reinforce the hose which is made in four sizes—¼, ⅜, ½, and ¾-inch ID. Dimensions are carefully controlled during manufacture for easy, consistent coupling.

Thermoid Co.
Trenton, N. J.
Circle 125 on Reader Service Card

GEAR PUMP
. . . has variable delivery

Designation: Model FV1

Features: Rate of flow can be controlled by hand while pump is in operation. Using the simple regulating screw, delivery is changed

KOHLER
Precision Controls

PLUG VALVES
for varied applications

Kohler Plug Valves will meet all your lower pressure installation and operating specifications. To mention a few—helicopter fuel system drain cock, hydraulic control valve for machine tool operation, shut-off valve for instrument air line, control valve for an industrial test stand.

Kohler Plug Valves have a forged aluminum body into which a stainless steel plug is precision lapped. Plug Valves are furnished with two, three or four ports with or without mounting flanges. Also available with two or three way drilled plugs.

Consult us on your next precision control requirements. Specific information will be furnished to help solve your individual design or production problem.

Kohler Co., Kohler, Wisconsin. Established 1873
KOHLER OF KOHLER
PLUMBING FIXTURES • HEATING EQUIPMENT • ELECTRIC PLANTS • AIR-COOLED ENGINES • PRECISION CONTROLS

without throttling. Very little heat is generated during operation.

Specifications: Gear pump measures 2⅜ x 3⅛ x 3½ inches. May be adjusted by hand or automati-

cally in stages of 1½ gallons per hour. Delivers fluid at any rate from 3½ to 10½ gallons per hour.

Nathan Manufacturing Corp.
Long Island City, N. Y.
Circle 126 on Reader Service Card

TWO-PRESSURE VALVE . . . for clamp circuits

Designation: Type E 360

Design: Conventional diaphragm top has been replaced with a small cylinder top with a low-friction

Teflon seal. All other moving hydraulic seals are also Teflon. A simple snap ring permits the release of the cylinder top which can be lifted off as an assembly. The check valve includes an improved guide and speed controlled disc movement. The automatic high pressure inlet valve operates without shock and is adjustable for a wide range of set points. Valve is designed for operation to 3000 psi. Simple internal construction and use of standardized components simplifies maintenance.

Emmett Machine & Mfg., Inc.
Akron, Ohio
Circle 127 on Reader Service Card

Continued on next page

"EMSCO is the practical answer to swivel joint problems"

When you buy a swing joint you buy two main benefits: Ease of turning and a good method of packing against leakage. Emsco offers you both.

With Emsco, load on the ball bearings is parallel to the lines of force and directly through center of the balls, thus reducing frictional torque for free turning under heavy loads. A patented packing and packing chamber design with easy take-up feature provides effective sealing against leakage; prolongs life of the joint indefinitely.

Emsco Swivel Fittings are manufactured in popular sizes for practically every type of service; from high vacuum to pressures of 15,000 p.s.i., and from sub-zero temperatures to 750° F. Simply tell us your application and type of end connections required.

When you buy a swing joint, specify Emsco.

THRUST BEARINGS FOR THRUST LOADS

EMSCO

EMSCO MANUFACTURING COMPANY
Box 2098, TERMINAL ANNEX
LOS ANGELES 54, CALIF.
Houston, Texas
Garland, Texas

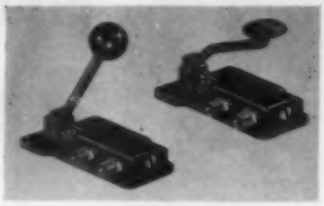
Circle 32 on Reader Service Card

New Products continued

VALVES
. . . for air control

Designation: Models No. 62, 75, 74

Features: Valves are supplied for foot, hand, or fingertip operation, and have ¼-in. NPT ports equipped with ¼-in. hose fitting connectors. Valves remain in open or closed position without constant pressure. Fingertip and hand control models have baseplate with mounting bosses for easy attachment to bench top or machine. These 3-way valves are used for instant operation of air devices.



W. R. Brown Corp.
Chicago, Illinois

Circle 128 on Reader Service Card

Why "Superior" (SAE) hydraulic tubing practically eliminates failure in critical hydraulic systems

The production of Superior (SAE) Hydraulic Tubing is carefully controlled from the melting of the steel to the final testing of the finished tube. The steel used is a non-aging type. It will not age harden in storage racks. Carbon content is held to 0.12% maximum (JIC Standards permit 0.18% and SAE Specifications 0.15%).

Mechanical properties more closely approach those of copper than any other steel products. Elongation, for instance, is 35% min. in 2" for tubes of ⅜" x .035" wall and over. This means that the tubing is easily hand bent and flared.

A clean, bright OD-ID finish is the natural result of the cold drawing and bright annealing practice standard at SUPERIOR, and the ends, both outside and in, are deburred. Furthermore, all tubing is thoroughly tested, as the pictures on the right show. Such quality practices give SUPERIOR tubing a tremendous advantage over annealed mechanical or pressure tubing—make it practically troublefree.

The selection of the proper tubing for your application depends on three factors: pressure, velocity and flow. Write for Superior Hydraulic literature. It lists recommended working pressures for Superior (SAE) Hydraulic Tubing and gives you the velocity and flow information needed to calculate the proper ID for tubing used in your equipment. Use the coupon.

TUBING MUST FLARE without difficulty and without forming minute surface notches or breaks. Each order of Superior (SAE) Hydraulic Tubing is tested for flareability.

EVERY SINGLE LENGTH of Superior (SAE) Hydraulic Tubing is 100% hydrostatic tested.

SUPERIOR TUBE COMPANY
2030 Germantown Ave., Norristown, Pa.

☐ Send me free Superior (SAE) Hydraulic literature.

☐ Send me a free sample of hydraulic tubing _____" OD and _____" wall to be used for _____

☐ Send the name and address of the distributor nearest me.

Name.....

Title.....

Company.....

Street.....

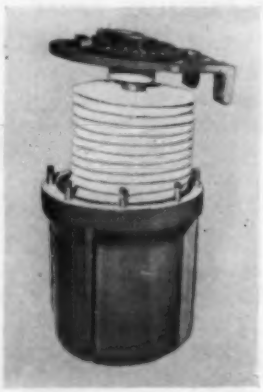
City.....Zone.....State.....

OIL FILTER
. . . has bolted-on head

Designation: Model I 6-15 D

Features: Filter is for flow rates of 5 to 50 gpm at pressures to 50 psi. Flow rates are dependent upon the dirt content and the viscosity of the liquid to be filtered. The filter will remove dirt particles measuring 3 to 5 micro inches.

Construction: Head and body of filter are attached by eight nuts.



Filter consists of a cast aluminum head and body. Head is bored and threaded for inlet and outlet lines. Series of metal screen discs completely covered by felt or cloth filter the oil. A spring-held perforated meal tube, extending from the bottom of the filter to the outlet, supports the filter discs and acts as a manifold. If required, a relief valve may be installed in conjunction with the external piping.

U. S. Hoffman Machinery Corp.
New York, New York

Circle 129 on Reader Service Card

PRESSURE GAGE
. . . has self contained design

Designation: Model 110

Design: Unit has an integral gage for process pressure indication and provides direct setting of the control point on the same calibrated

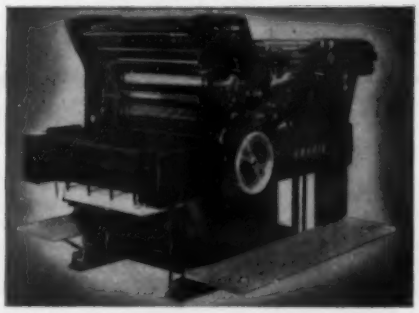
Continued on page 90

Circle 36 on Reader Service Card

GAST MODEL 10 X 1040 VACUUM PUMP.

●

At 26" vac., one sq. inch of vacuum cup area will hold 13 lbs.—one sq. ft. of vacuum cup area holds 1,872 lbs.



What GAST Air Pumps do on Printing Equipment may spark valuable ideas for your

AUTOMATIC MACHINES

Automation's an old story to printers! For years they've cut costs with equipment that performs multiple separate, consecutive operations automatically, like this printing press . . . or the paper folder . . . or collator.

For years too, dependable, efficient Gast rotary Air Pumps have been used on such equipment—providing suction to hold, lift or feed stock . . . pressure to float stock, blow powder, etc.

Perhaps *your* product would benefit with a Gast Rotary to perform similar functions—or to position, push, pull, suck, inflate, evacuate, aerate, or atomize? *For details on 35 actual applications, write for "Application Ideas" Booklet!* **Gast Manufacturing Corp.**, P.O. Box 11-D, Benton Harbor, Michigan.

Original Equipment Manufacturers for Over 25 Years

GAST ROTARY

- AIR MOTORS TO 3 H.P.
- COMPRESSORS TO 30 P.S.I.
- VACUUM PUMPS TO 28 IN.

See Our Catalog in Sweet's Product Design File

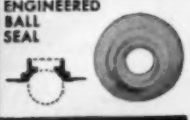
WHAT WILL YOU HAVE IN TEFLON?

Contact SPARTA for Teflon Custom-Molding

PARTS ILLUSTRATED ARE NOT STOCK ITEMS BUT ARE DEVELOPED AND ENGINEERED IN CLOSE COOPERATION WITH CUSTOMERS AND THEIR ENGINEERS FOR SPECIFIC END USES AND APPLICATIONS.

DIAPHRAGM SHIELD

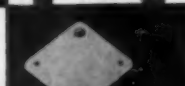
APPLICATION-ENGINEERED BALL SEAL



SHAFT SEAL

CUP SEALS

TEFLON IMPREGNATED WITH GRAPHITE



SUCCESSFUL SEALING APPLICATIONS RESULT FROM ACCURATE CONTROL OF WEB AND LIP THICKNESSES, THUS ATTAINING DEGREE OF FLEXIBILITY DESIRED

⅛" UNDER CUT .015" THICK

PUMP DIAPHRAGM

SEND FOR NEWEST BULLETIN 135 OF TEFLON ACCOMPLISHMENTS AND LATEST TEFLON PROPERTIES.

APPLICATION ENGINEERED BALL SEAL

SPARTA MANUFACTURING CO.

P. O. BOX 66-AH
DOVER, OHIO
PHONE 4-2755

Circle 81 on Reader Service Card

Mounted atop the press head are two Hele-Shaw High Pressure Pumps . . . each with 33 g.p.m. maximum capacity, with remotely controlled pressure-responsive controls, for pressures up to 2500 p.s.i.

HELE-SHAW PUMPS GIVE LOOP FRAME PRESS A 3000-TON "WALLOP"

EDWIN L. WIEGAND COMPANY, Pittsburgh, Pa., makers of the famous Chromalox Heaters, needed a special 3000-ton Up-acting Loop Frame Press. They called on The Watson-Stillman Company who designed and built the press and powered it – as so many of Wiegand's machines are powered – with Hele-Shaw Pumps.

The Hele-Shaw Pump is a radial-piston variable displacement fluid power generator for pressures up to 3000 p.s.i. It can be very readily applied to the machine it serves...installed on the machine, near it, remote from it, or integrated with the design itself.

When ordering hydraulically-operated equipment, specify Hele-Shaw Pumps for top efficiency, reliability and service economy. There's a Hele-Shaw of the right size, capacity and pressure for practically any application.

Write for full information on the Hele-Shaw or, if you need a pump for constant displacement from 3 to 100 g.p.m., ask for literature on the AE Hydramite. American Engineering Co., 2530 Aramingo Ave., Philadelphia 25, Pa.

AMERICAN ENGINEERING
COMPANY
PHILADELPHIA 25, PENNA

CANADIAN SUBSIDIARIES: Affiliated Engineering Corporations, Ltd., Montreal 16, P. Q. Bawden Industries Ltd., Toronto 3, Ont.

AE Products are: Marine Deck Auxiliaries, Hele-Shaw and Hydramite Fluid Power, Lo-Hed Hoists, Lo-Hed Car Pullers, Taylor and Perfect Spread Stokers

Circle 6 on Reader Service Card

When we say longer, we mean

L-O-N-G-E-R

For a Money-Back Guarantee of Longer Service, specify

Promet Engineered Bronze

BEARINGS-BUSHINGS
WEARING PARTS

Guaranteed superior service or refund of purchase price upon return—the customer's opinion is final. Promet Bearings stay on the job, hours on end with never a doubt. They've got what it takes and can take it! Write for free literature and service data sheets. Send blueprints, conditions of operation and other data for recommendations and quotations. You are invited to discuss your bearing problems with our metallurgists, engineers and laboratory technicians.

THE
American Crucible
PRODUCTS CO.
"Bearing Specialists Since 1919"
1303 OBERLIN AVENUE, LORAIN, OHIO, U.S.A.

New Products continued

gage dial. All-metal power relay makes possible low nozzle pressures for linear response and output pressure up to 30 psi for positive valve action. The sapphire nozzle feed orifice is equipped with a pushbutton cleaner.

Features: Switching to a different control action, setting the control point, or reversing output action are all accomplished by turning knobs or friction screws. Bourdon elements range from 0-15 to 0-10,000 psi. Corrosion resistant materials and finishes are used throughout.

Hammel-Dahl Co.
Providence, R. I.
Circle 130 on Reader Service Card

PORTABE OIL FILTER
. . . for removing solids, sludges, acids

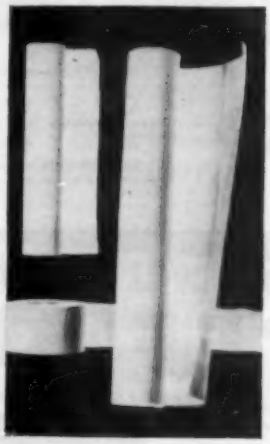
Design: Filter has heavy duty heater and adjustable thermostat.

Two 10-inch oil resistant hoses are furnished, and unit is completely piped and wired. Filter has pressure and temperature gages and a swing bolt cover. Large ball bearing, rubber tire casters permit easy moving. Filter cartridges may be expendable or repackable type and are available for removal of all types of contaminants.

The Hilliard Corp.
Elmira, N. Y.
Circle 131 on Reader Service Card

TEFLON TAPE
. . . in 24-inch widths

Features: Tape is available in quantity for aircraft, hydraulic, and industrial uses, in thickness varying from 0.005 to 0.125 inches. Non-adhesive and chemically inert, the tape combines toughness, excellent electrical properties and resistance to abrasion and corrosive chemicals



at high and low temperatures. Because of good elongation, it fits tightly over sharp bends and corners, and tends to return to its original shape when heated. Service life far exceeds conventional gasket materials when used as a gasket liner in equipment handling corrosive chemicals.

W. S. Shamban & Co.
Culver City, Calif.
Circle 132 on Reader Service Card

IN-LINE ACCUMULATOR
. . . eliminates surges

Designation: Desurger

Design: Unit has throttling orifices which allow excess fluid to act against a coaxial sleeve that is counterbalanced by gas pressure. Accumulator prevents pulsations and pressure surges by discharging excessive pressures through specially

Continued on page 92

Circle 58 on Reader Service Card

COMPRESSED AIR AND GAS COME OUT OF THE LOGAN ARIDIFIER

Scrubbed CLEAN AND DRY

INSTALL ARIDIFIERS ON LINES SERVING

- Paint Spray Guns
- Air Tools
- Air Hoists
- Foundry Jolting Machines
- Sand Blasting Tools
- Sand Blasting Rooms
- Metal Spray Guns . . . or Wherever the line must deliver clean, dry air or gas

On any air or gas line 92% of the dirt, oil, scale and water that enter the Aridifier is trapped and removed from circulation. The Aridifier's patented centrifugal-baffle action scrubs air and gas clean and dry . . . protects equipment, prevents freezing, fouling, corrosion and caking, produces best results with spray gun and air tool operations, etc. Easy to install. Self cleaning. Maintains itself. 10 models available. Capacity 7 CFM to 17,000 CFM.

Learn HOW the Aridifier scrubs with a patented centrifugal-baffle action.

Write for This Catalog

Now!

Logan ENGINEERING CO.

4920 W. Lawrence Ave., Chicago 30, Ill.

BOOST 100 PSI AIR PRESSURE TO 30,000 PSI FLUID PRESSURE

for...

$289.50

(F.O.B. Gardena, Calif.)

Continuous-acting, air-driven. Various ratios give maximum fluid pressures of 100 to 50,000 psi. Size: 8¼" wide x 9⅝" deep.

Eight standard models. Special models for lower or higher pressures. Applicable wherever low-volume output at high pressures is the requirement, such as static testing, powering presses for forming, shearing, clamping, etc. Thousands in use. Complete power packages also available. Send for Bulletins.

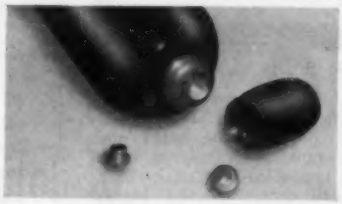
SPRAGUE

Engineering Corporation

• 1144 WEST 135th STREET, GARDENA, CALIFORNIA •

PROTECT YOUR PRODUCT USE A CLOVER CLOSURE

Here's how one manufacturer insures his quality:



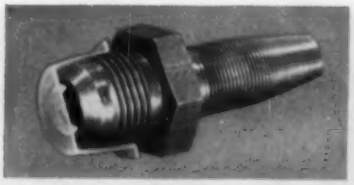
"We use the Clover Aluminum Pipe Plug principally because it is easy to apply. Their favorable acceptance to the trade may be attributed to:

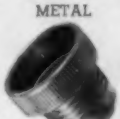
- **Ease in removing**
- **No chance to impair threads**
- **No loose particles to fall free**
- **No odor**

This Clover product is used as a shipping plug in cylinders manufactured by the Harrisburg Steel Corp. with plants at Harrisburg, Pa., and their Taylor-Wharton Div. at Easton, Pa.

Designed to protect valves, fittings and component parts from dust, dirt, moisture and possible thread damage . . . Clover offers the most COMPLETE line of metal and plastic closures in the field.

Plastic Self Sealing Caps for AN and SAE fittings



METAL	PLASTIC POLYETHYLENE	METAL
		
Threaded caps for AN and SAE external threaded parts	Tapered parts for use either as a cap or a plug.	Threaded plugs for AN and SAE internal threaded parts

Solving closure problems for manufacturers who demand the best protection has been a specialty of Clover Industries for nearly 12 years. Can we help solve yours?

Write today for free samples and literature.

Clover Industries, Inc.

582 Young St. Tonawanda, N. Y.

Circle 83 on Reader Service Card

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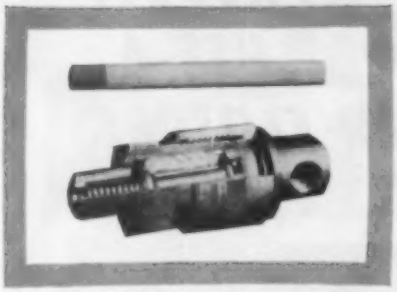
HUSCO
Hydraulic Controls are COST-SAVERS



Husco No. 4000 Rotary Swivel

This low cost, high efficiency Rotary Swivel is designed for both high pressure and high operating speeds in the brake and clutch field. Compact, for use in close quarters, it has spring-loaded Teflon rings, self-centering ball thrust bearing, highly efficient axial bearings. Size, only 3" x 1⅛".

Check HUSCO *first* for experienced custom engineering in Hydraulic Controls—Valves, Cylinders, Pumps—on your new designs. Write for details.

HUSCO **HYDRAULIC UNIT SPECIALTY CO.**
Pumps • Valves • Cylinders
Waukesha, Wis.

New Products continued

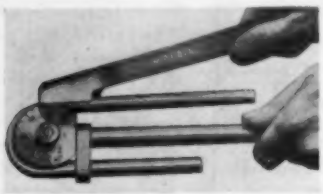
designed throttling orifices. Double-acting, through-flow, in-line construction of the accumulator places all fluid under control. When ex-

treme variations exist, a high-pressure unit is used in tandem with a low-pressure unit. Sizes are available with volumetric capacities to 1400 cu. in.

Westinghouse Air Brake Co.
Wilmerding, Pennsylvania
Circle 133 on Reader Service Card

TUBE BENDER
. . . for hard or soft tubing

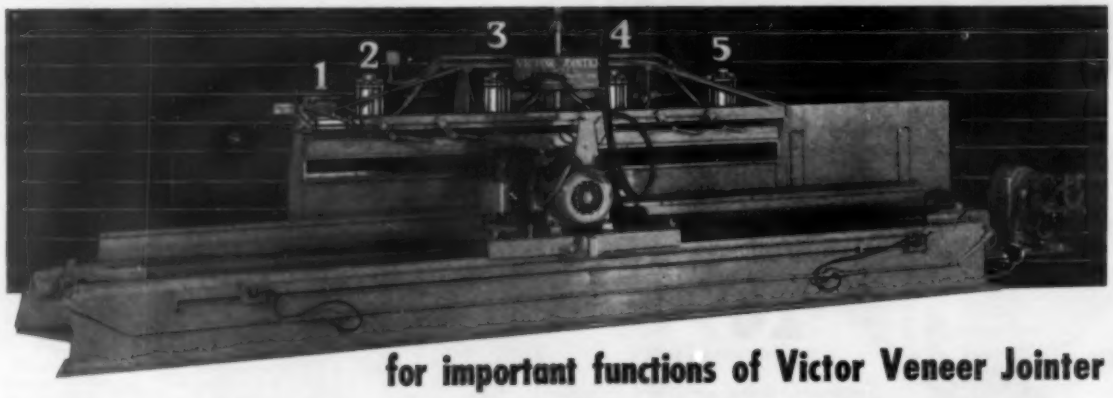
Design: Bender is of the open-side type making it possible to slip the bender over the tubing at the exact place the bend is desired. This makes it especially handy in hard-to-get-at places where tubing has one end connected. Bends can be made to any angle to 180 degrees without adjusting tubing or bender. The bending form is calibrated to show degree positions. Benders are available for tubing from ⅛ to ⅜ inches.



Features: Benders can be used for bending hard drawn copper, stainless steel, and JIC steel tubing. It is not necessary to use a clamp when bending to keep the tube from slipping.

The Imperial Brass Mfg. Co.
Chicago, Illinois
Circle 134 on Reader Service Card

5 NOPAK Cylinders supply pressure and pull



for important functions of Victor Veneer Jointer

The Victor Straight-Line Veneer Jointer, built by the E. V. Prentice Co., Portland, Ore., employs a NOPAK Model E 2½" x 6" Cylinder to operate the stops which align the stock, and 4 NOPAK Model D, 6" x 5" Cylinders to exert adequate, equalized clamping pressure on the full length of the stock to be joined. All cylinders are controlled from a single station to provide for fast precision alignment and clamping in a rapid, repetitive work cycle.

This is another example of the important role played by NOPAK Cylinders and Valves in actuating and controlling precision machine movements. Others are shown in the NOPAK Application Manual. Ask your NOPAK Representative to show you this helpful book.

Refer to Classified Section of your Telephone Directory for name of nearest NOPAK Representative.

GALLAND-HENNING NOPAK DIVISION
2743 S. 31st STREET • MILWAUKEE 46, WISCONSIN

NOPAK
® VALVES AND CYLINDERS
DESIGNED for AIR and HYDRAULIC SERVICE

FLOW CONTROL VALVE
. . . of simple construction

Features: For use with water, oil, or gas the valve withstands pressures to 1500 psi. Simple rotation of the outside knurled sleeve provides positive flow control.

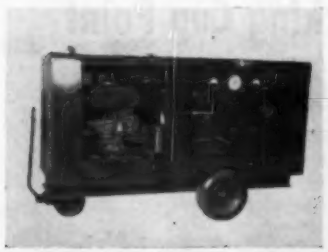
Construction: Unit has only three major parts and is designed for

rough usage with no fragile parts. Has no valve seats liable to leak or places for dirt to lodge. Eight adjustment points are provided for one revolution of the regulating sleeve. Each adjustment increases or decreases the orifice .004 inch assuring very sensitive control. Unit weighs 4 oz.

Burklyn Co.
Los Angeles, Calif.
Circle 135 on Reader Service Card

TEST STAND
. . . for jet aircraft

Designation: Model PG-EPH-1
Features: Single unit combines facilities for testing electrical, hydraulic, and pneumatic systems of latest jet aircraft. Unit incorporates a 30 gpm, 5000 psi hydraulic system and



a 5000 psi air system. Where space is a factor, this compact combination unit fills a special need. All-steel housing of the test stand is weatherproof and unit is equipped with pneumatic tires, brake, and tow bar assembly.

Greer Hydraulics, Inc.
New York International Airport
Jamaica 30, N. Y.
Circle 136 on Reader Service Card

PROTECTIVE CLOSURES
. . . of rubber and plastic

Application: Closures are used for protection of threaded openings and

Continued on next page

. . . switch to
UCON Hydrolubes
Trade-Mark

For maximum fire-resistance, maximum protection for men and machines, change to UCON Hydrolubes—CARBIDE's safety hydraulic fluids. Severe, exhaustive laboratory tests and 7 years' industrial use have proved their resistance to burning.

UCON Hydrolubes are balanced formulations. They contain modern synthetic lubricants and anti-wear agents for lubricity, water for non-flammability, effective liquid and vapor phase corrosion inhibitors for the protection of your equipment, an anti-freeze to keep the pour-point low (below minus 55°F).

You don't have to revamp your equipment to change to UCON Hydrolubes. They have no harmful effects on packings and seals . . . are supplied in a range of viscosity grades . . . have high viscosity indexes (150 to 160) . . . present no toxicity problems.

Remember: **SAFETY** *is no accident . . . return the coupon today.*

UCON Hydrolubes *are products of . . .*
Trade-Mark

CARBIDE AND CARBON CHEMICALS

CARBIDE AND CARBON CHEMICALS COMPANY
A Division of Union Carbide and Carbon Corporation
30 East 42nd Street UCC New York 17, N. Y.

Please send me the booklet "UCON Hydrolubes," Form 7380.

Name_____

Company_____ Position_____

Address_____

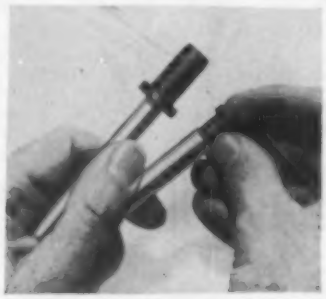
_____

"Ucon" is a registered trade-mark of Union Carbide and Carbon Corporation.

New Products continued

connections against damage, prevention of moisture or dust penetration, to seal in gases and liquids, and to mask pipe or tube ends from paint spray and preservative finishes.

Design: Rubber caps and plugs are produced from sulphur-free black



rubber or from Neoprene, Hycar or natural rubber. Caps accommodate tubing from 1/16 to 2½-inch OD and plugs are for 7/16 to 3-inch ID. Plastic units are molded Vinyl or polyethylene. They are flexible, tough and impervious to practically all commercial gases and fluids. Available as caps for tubing from ⅛ to 1½ inch OD or as plugs from 3/16 to 1⅜ inch ID.

Ray A. Scharer & Co.
Detroit, Michigan

Circle 137 on Reader Service Card

AIR CONTROL ASSEMBLY
. . . with automatic water discharge

Design: Assembly consists of filter with automatic-unloading water trap, regulator with 0-160 psi gage, and automatic lubricator. Water accumulates to a predetermined level in upper filter bowl, then drains into the float-valve equipped lower bowl. When water reaches sufficient depth, the float valve opens to discharge excess water. Sufficient water level is maintained in both bowls to provide a constant seal against air leaks.

Features: No attention is required beyond occasional refilling of lubri-

cator, and a supply of clean, lubricated, water-free air is automatically maintained at the desired preset pressure.

Modernair Corp.
San Leandro, Calif.

Circle 138 on Reader Service Card

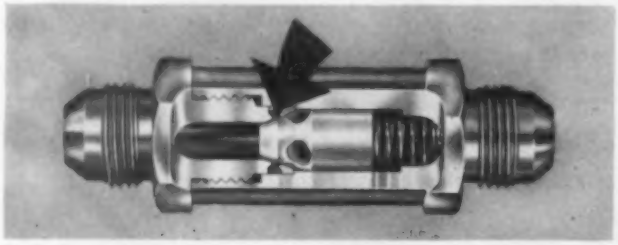
2-WAY VALVE
. . . for mobile equipment

Designation: Model 23

Features: Valve is positive-locking, light weight, push-pull type for

Continued on page 96

The **FLEXIBLE SEAL SEAT*** Simple, Secure, Long-Lasting!



Responsive action of the soft O-ring seal provides absolute leak-tightness. Instantly compresses to seal internal and external pressures. Draws harmlessly around dirt particles. No costly precision parts; no extra end seals. Stocked in 6 standard Dryseal pipe and JIC tube sizes; 12 connection combinations. Write for data sheet.

KEPNER PRODUCTS COMPANY
7321 West 59th Street • Summit, Illinois

Kep-O-seal

HYDRAULIC & PNEUMATIC
CHECK VALVES

* PATENT APPLIED FOR

Circle 50 on Reader Service Card

UNBRAKO

Self-Locking Cup Point

Prevents this set screw from working loose

Unique counterclockwise knurls prevent these socket set screws from working loose, even in poorly tapped holes. And UNBRAKO Self-Locking Socket Set Screws can be seated tighter than ordinary set screws—as much as 45% tighter. For complete information, see your local UNBRAKO industrial distributor or write STANDARD PRESSED STEEL CO., Jenkintown 2, Pa.

UNBRAKO SOCKET SCREW DIVISION SPS
JENKINTOWN PENNSYLVANIA

Circle 85 on Reader Service Card

YOU ARE CHOSEN...

because you qualify!

Do *you* know why you get this magazine without charge? How can the publisher *afford* to send you this leading national magazine every month—without cost to you? Here's why . . .

Advertisers insist on Quality Readership

It's that simple!

Your local hydraulic equipment distributor *pays us* for your subscription to APPLIED HYDRAULICS because he knows you are an important hydraulic equipment user; because he knows you are responsible for specifying and/or buying hydraulic equipment. Naturally, he is only willing to spend this kind of money on his best and most important customers.

This type of circulation is called Franchise Circulation

APPLIED HYDRAULICS readers are *hand-picked*. They are important people in the hydraulic equipment field—they are carefully chosen because of their interest in new and better hydraulic products, equipment and techniques.

That's why—APPLIED HYDRAULICS spends considerable time, money and effort on every issue to make it worthwhile reading—realistically helpful, intelligently interesting and useful to our 22,449 *important readers.*

FRANCHISE CIRCULATION

APPLIED HYDRAULICS

1240 ONTARIO STREET • CLEVELAND 13, OHIO

ADEL *Industrial Hydraulic Equipment*

for PEAK PERFORMANCE ADEL Hydraulic Valves and Pumps are setting new and ever higher standards for precision in manufacturing and efficient performance in operation. Following are but a few of the wide variety of models to meet all operating conditions.

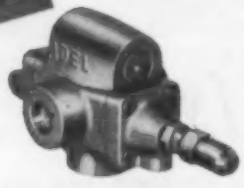
GEAR-TYPE HYDRAULIC PUMPS

For 1000 psi service with rated capacities at 1800 rpm of from 1.5 to 46.8 gpm.

DIRECTIONAL CONTROL VALVE

4-way valves with spring-centered, spring-offset, and 1, 2, or 3 position detent action. 1500 psi. Flows to 28 gpm.

BY-PASS VALVES



Relief, Sequence and Unloading valves. Direct or remote operation, 50 to 1500 psi range.

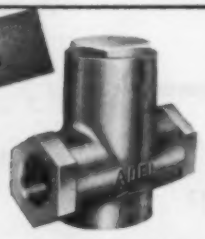
VOLUME (FLOW) CONTROL VALVES

Compensated type maintains constant flow over wide differential pressure range. No drain line required. 1500 psi.

PILOT VALVES

2 or 3 position detent. With or without dog or lever. Can be used as 4-way valve in small circuits. 1000 psi.

CHECK VALVES



Valves allow free flow in one direction only. Many variations available. 3000 psi.

For complete engineering specifications and counsel, Address: ADEL DIVISION—GENERAL METALS CORPORATION, 10771 Van Owen Street, Burbank, California.

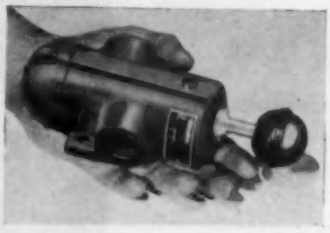
ADEL
PRECISION PRODUCTS
A DIVISION OF GENERAL METALS CORPORATION

Manufacturers of Industrial Hydraulic Valves and Pumps

DISTRIBUTORS: AIR-DRAULIC EQUIPMENT CO., HOUSTON, TEX. • AIR & HYDRAULIC ENGINEERING CO., NEW HAVEN, CONN. • RUSS CHAMBERLIN COMPANY, PORTLAND 14, ORE. J. BOYD COATES, GLENSIDE, PA. • CORBY SUPPLY COMPANY, ST. LOUIS, MO. • FRANK T. DONNELLY COMPANY, PITTSBURGH 38, PA. • HASKEL ENGINEERING & SUPPLY CO., GLENDALE 4, CALIF. • HASKEL ENGINEERING & SUPPLY CO., SAN FRANCISCO 7, CALIF. • AIR-DRAULICS COMPANY, PHOENIX, ARIZ. • INDUSTRIAL AIR & HYDRAULIC EQUIP. CO., DETROIT 15, MICH. LINCOLN SUPPLY COMPANY, PROVIDENCE, R. I. • L. H. MONSEES, INDEPENDENCE, MO. • THE NEFF ENGINEERING CO., FORT WAYNE 3, IND. • POWER DRIVES, INCORPORATED, BUFFALO, N. Y. • SCOTT EQUIPMENT & ENGINEERING CO., DAYTON 10, OHIO • ROBERT TAYLOR & SONS, SALT LAKE CITY 10, UTAH • WYATT SALES COMPANY, CLEVELAND 15, OHIO
TRI-STATE SUPPLY COMPANY, BROOKLYN 33, N. Y.

New Products / continued

flows from 8 to 10 gpm at 1000 psi. Manually operated, it can be readily adapted to remote control. Easily mounted in any position, the unit is equipped with dust and



moisture seals. Overall dimensions are 8½ x 3¼ inches and weight is 5¼ lbs. Valve is especially designed for agricultural, material handling, and truck handling equipment.

Wisconsin Hydraulics, Inc.
Milwaukee, Wisconsin

Circle 139 on Reader Service Card

TIME SWITCH

. . . for automatic control of operations

Features: Dial of switch is scaled in 15-minute graduations and can be set for as many as 48 on-off operations. Adjustment for the complete schedule is made by sliding

the self-contained, non-removable trip levers in or out. Switch is available with or without a calendar device to cut out non-working days.

Specifications: Rated capacity is 1000 watts. Operates on 60-cycle, 110/240 volt line. Unit incorporates a single-pole, double-throw switch.

Zenith Electric Co.
Chicago, Illinois

Circle 140 on Reader Service Card

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1	18	35	52	69	86	103	120	137	154	171	188	205	222	239	256	273	290	307	324
2	19	36	53	70	87	104	121	138	155	172	189	206	223	240	257	274	291	308	325
3	20	37	54	71	88	105	122	139	156	173	190	207	224	241	258	275	292	309	326
4	21	38	55	72	89	106	123	140	157	174	191	208	225	242	259	276	293	310	327
5	22	39	56	73	90	107	124	141	158	175	192	209	226	243	260	277	294	311	328
6	23	40	57	74	91	108	125	142	159	176	193	210	227	244	261	278	295	312	329
7	24	41	58	75	92	109	126	143	160	177	194	211	228	245	262	279	296	313	330
8	25	42	59	76	93	110	127	144	161	178	195	212	229	246	263	280	297	314	331
9	26	43	60	77	94	111	128	145	162	179	196	213	230	247	264	281	298	315	332
10	27	44	61	78	95	112	129	146	163	180	197	214	231	248	265	282	299	316	333
11	28	45	62	79	96	113	130	147	164	181	198	215	232	249	266	283	300	317	334
12	29	46	63	80	97	114	131	148	165	182	199	216	233	250	267	284	301	318	335
13	30	47	64	81	98	115	132	149	166	183	200	217	234	251	268	285	302	319	336
14	31	48	65	82	99	116	133	150	167	184	201	218	235	252	269	286	303	320	337
15	32	49	66	83	100	117	134	151	168	185	202	219	236	253	270	287	304	321	338
16	33	50	67	84	101	118	135	152	169	186	203	220	237	254	271	288	305	322	339
17	34	51	68	85	102	119	136	153	170	187	204	221	238	255	272	289	306	323	340

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12	29	46	63	80	97	114	131	148	165	182	199	216	233	250	267	284	301	318	335
13	30	47	64	81	98	115	132	149	166	183	200	217	234	251	268	285	302	319	336
14	31	48	65	82	99	116	133	150	167	184	201	218	235	252	269	286	303	320	337
15	32	49	66	83	100	117	134	151	168	185	202	219	236	253	270	287	304	321	338
16	33	50	67	84	101	118	135	152	169	186	203	220	237	254	271	288	305	322	339
17	34	51	68	85	102	119	136	153	170	187	204	221	238	255	272	289	306	323	340

Circle # on Reader Service Card

Useful Literature continued

EXPLOSION-PROOF MOTOR . . . manufactured by U. S. Electrical Motors Inc. is discussed in Bulletin 1879. Features shown in the booklet include the compact design of the motor with the same horse-power being provided in less space than previous models. Greater protection is provided by improved types of enclosure, precision register fits, closer tolerances in machining, and other structural refinements. The frame is heavily ribbed around the entire unit for added strength and rapid heat dissipation. An improved seal on the shaft prevents moisture from entering the interior.

Circle 171 on Reader Service Card

HYDRAULIC TRANSMISSION . . . for infinitely variable speeds to 1500 rpm without gearing is presented in Gerotor May Corp. Catalog Section T-100. The material describes features of the combination pump-motor hydraulic unit which has a maximum horsepower of 3.5 in the speed range of 425 to 1500 rpm. Both the pump and the motor have variable displacements for regulation of the output speed at constant torque or constant horsepower. The unit permits smooth braking and reversing and is controlled by manual controls or a wide variety of remote controls which can be obtained for specific needs.

Circle 172 on Reader Service Card

RELIEF VALVES . . . for farm machinery, road machinery, and industrial uses are specified in catalog sheets available from Fluid Controls, Inc. These sliding spool valves are designed to control pressure in systems where it is not necessary that the valve close without leakage and high flow capacity is required. Relief pressure is constant and not affected by flow, temperature, or oil viscosity. The pilot-type valves range from ¼ to 1-inch port size.

Circle 173 on Reader Service Card

AIR COMPRESSORS . . . for compression of air or gas entirely free of oil are presented in Bulletins 604 and 605 from Pennsylvania Pump & Compressor Co. The bulletins explain the main features of the compressors and show cutaway drawings of the units which are single-stage, double acting, horizontal compressors. They are water cooled, and have a non-lubricated sectionalized cylinder construction and a special enclosed dust-tight distance piece between the cylinder and frame to ensure that no part of the piston rod entering the frame will alternately enter the stuffing box.

Circle 174 on Reader Service Card

TIME TOTALIZERS . . . are featured in a brochure issued by The R. W. Cramer Co., Inc. One application of this equipment is to indicate operation hours of automatic equipment to forecast servicing needs. The units are equipped with a high torque synchronous motor operating a precision, five-digit counter through a gear train. Some types have a reset mechanism which makes it possible to return the register to zero at any time.

Circle 175 on Reader Service Card

BRONZE VALVE . . . is featured in Circular 602 from Lunkenheimer Co. The circular graphically presents the construction and design of the new valve. The bronze globe valve has a flat seat and disc which are lapped to obtain a smooth, flat, leak-proof seal. The perfectly flat surfaces are integral parts of the valve and do not require replacement or regrinding. The valve has a deep, well-packed stuffing box which can be repacked when the valve is open and under pressure. The hand wheel is of non-slip design.

Circle 176 on Reader Service Card

THREADLESS SUBPLATES . . . for mounting valves and other controls are explained and described in Bulletin H55 prepared by Petch Manufacturing Co. The bulletin presents the principles of threadless subplates and shows the installation of the three elements which are inserts, lockplate, and baseplate. The insert combines the sealing face for

Continued on next page

KRAISSL

• Since 1926 • in the application, design and manufacture—pumps, separators, hydraulic accessories.

EQUIPMENT FOR FLUID POWER TRANSMISSION

Primary Oil Pumps • Vacuum Powered Transmission and Low Pressure Air Service • Air and Liquid Filters •

What's your problem?

- higher pumping speeds?
- tolerance of particle-laden liquids?
- peak suction for primary pumps?

the Kraissl-50 Roller Pump

is unmatched for dependable performance on every one of those counts.

Bulletin A-1330 has full data . . . write for it. The roller-rotor design easily handles particles that would jam more tightly-fitted mechanisms—reduces cavitation, allowing higher speed operation*—develops high suction characteristics.

*Roller mechanisms permit higher speeds with any oil than most displacement designs.

KRAISSL CO

305 Williams Ave., Hackensack, N.J.

Circle 46 on Reader Service Card

for SUPERIOR DESIGN

use... Hydro-Line CYLINDERS

SERIES "J" CYLINDERS

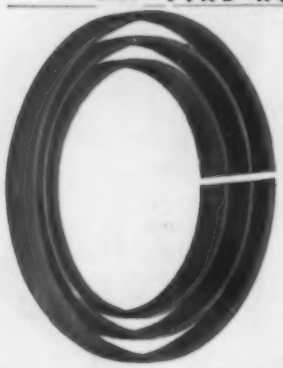
for rugged, trouble free service

- *CARTRIDGE . . . rod-wiper, packing, bushing in one unit.*
- *RUGGED BODY . . . all steel end caps and barrel.*
- *PISTON RINGS . . . step-cut joint, sealing in both directions, long life, minimum leakage.*
- *PRESSURE . . . 2,000 psi heavy-duty . . . 3,000 psi non-shock.*
- *SIMPLICITY . . . no tie-rods . . . no retainer rings.*

Write for Bulletin No. 53

Hydro-Line *Manufacturing Co.*

5605 PIKE ROAD • ROCKFORD, ILLINOIS



Check AUTO-DIESEL LONG-WEARING Guide Rings for SINGLE ACTING HYDRAULIC CYLINDERS

Here is a NEW bronze Guide Ring developed by Auto-Diesel Engineers for single acting hydraulic cylinders that you should check. This ring is badly needed because it is LONG-WEARING and will give much longer service. They are made from 2" up to and including 10" in diameter and in widths from ¼" to 1½". It will pay to find out what they will do for you.

You can buy Quality AUTO-DIESEL Piston Rings in SHORT RUNS at ATTRACTIVE PRICES!

It is a problem for many to obtain piston rings in small runs and get them quickly. Since 1921 several hundred firms have been buying Auto-Diesel Piston Rings exclusively. They can buy in small runs, get fast service and at ATTRACTIVE PRICES. Can make up to 35" diameter for original equipment and replacement in compressors, hydraulic cylinders, valves, etc. Will make circular parts to your specifications.

Write for Details

THE AUTO-DIESEL PISTON RING CO.
3137 Superior Avenue • Cleveland 14, Ohio
"RINGS and SHAPES Since 1921"

Circle 11 on Reader Service Card

Useful Literature / continued

the O-ring seal, the fluid passage through the subplate, and the tube fitting connector body. The design eliminates leaks due to the porosity of the baseplate casting. Because no pipe threads are required, this source of leaks is also eliminated. The bulletin includes data on subplate assemblies for volume, pressure, and directional controls.

Circle 177 on Reader Service Card

COMPRESSORS . . . of balanced opposed design are introduced in a 32-page booklet available from the Worthington Corp. The booklet, attractively illustrated with many cutaway drawings, presents the basic principles of the design and states its advantages for applications requiring from 300 to 10,000 hp. Each feature of the compressor is explained and illustrated and outstanding characteristics are pointed out. The opposed cylinder design eliminates vibration problems and requires a minimum foundation and floor space. The compressor permits ready accessibility to all cylinders and running gear and offers a flexibility in the choide of a prime mover.

Circle 178 on Reader Service Card

PRESSURE-FILLED O-RINGS **. . .** consisting of a hollow metal ring containing an inert gas under pressure are reviewed in a pamphlet prepared by J. V. Tripoli & Co. The O-rings provide a metal-to-metal joint with some degree of expansion and contraction between the jointing surfaces. Pressures up to 20,000 psi have been sustained for long periods at room temperature, and the O-rings have withstood pressures of 600 psi at temperatures above 1000 degrees F. The rings are used on high-pressure hydraulic valve and piping joints and in other applications where high pressures and temperatures are encountered. Sizes range from ½-inch to 96-inch OD.

Circle 179 on Reader Service Card

SELF-LOCKING NUTS . . . are the subject of a folder offered by Standard Pressed Steel Co. Explaining the principle of the self-locking design, the folder illustrates several applications including machine tools, materials handling equipment,

and steel making equipment. Drawings illustrate the locking action of the one-piece, all-metal nut which can be used either as a locknut or a stop nut. The fasteners are available in regular heights and thin-nut heights and can be re-used repeatedly. The resilient locking segments of the nut are adjusted to control locking torques.

Circle 180 on Reader Service Card

SPEED MEASURING INSTRUMENT . . . operating on the stroboscopic principle is presented in a brochure from Boulin Instrument Corp. Useful for determining the speed of a pump or other rotating device, the portable instrument is not dependent on electric current, can be used in potential fire hazard areas with absolute safety, and is not affected by changes in temperature or by humidity. The instrument is hand held and weighs only 11 oz.

Circle 181 on Reader Service Card

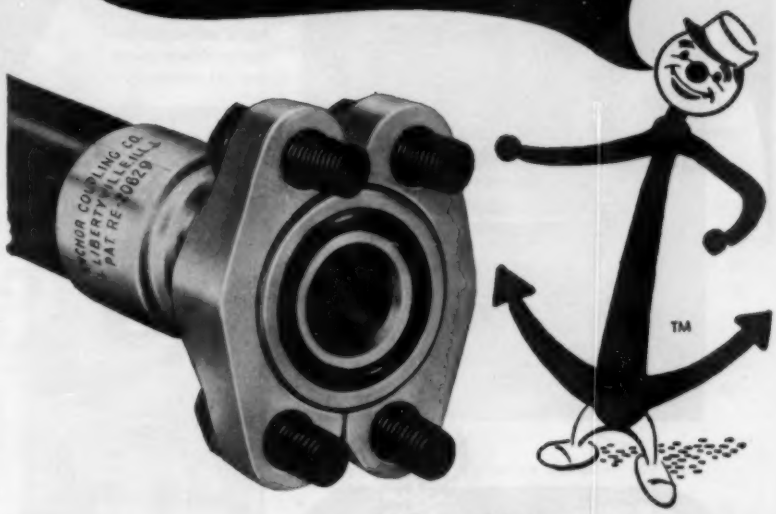
SINTERED BRONZE FILTERS . . . for conditions of performance, corrosive fluids, and temperature extremes which prohibit conventional filters are discussed in a 16-page booklet which has been developed by Permanent Filter Corp. Sintered bronze is a relatively new filtering medium made by fusing millions of bronze balls into a porous element that never needs replacing and is unaffected by extreme temperatures and most corrosive fluids and gases. The booklet includes basic information on the advantages of porous bronze as a filtering medium and engineering data on bronze filters already in production for aircraft and industrial applications. Specifications and features of models manufactured by the company are given.

Circle 182 on Reader Service Card

GASKET MATERIALS . . . Armstrong Cork Co. has issued a 24-page manual covering their materials for gaskets. Features of cork-and-rubber compositions are discussed and specifications and characteristics are tabulated. Stress-strain characteristics are indicated and a graph shows the percentage of compression per unit load. Similar information is given for cork compositions, synthetic rubber compounds, cushioning materials, and fiber sheet materials. A section is

Continued on next page

The Higher the Pressure
The Tighter the Seal —
that's the story with —



ANCHOR
FLANCO
4-Bolt, Split-Flange Couplings

— The static "O" ring seal eliminates the use of gaskets, sealing compounds and tapered threads. The higher the pressure in the line — the tighter the "O" ring seals.

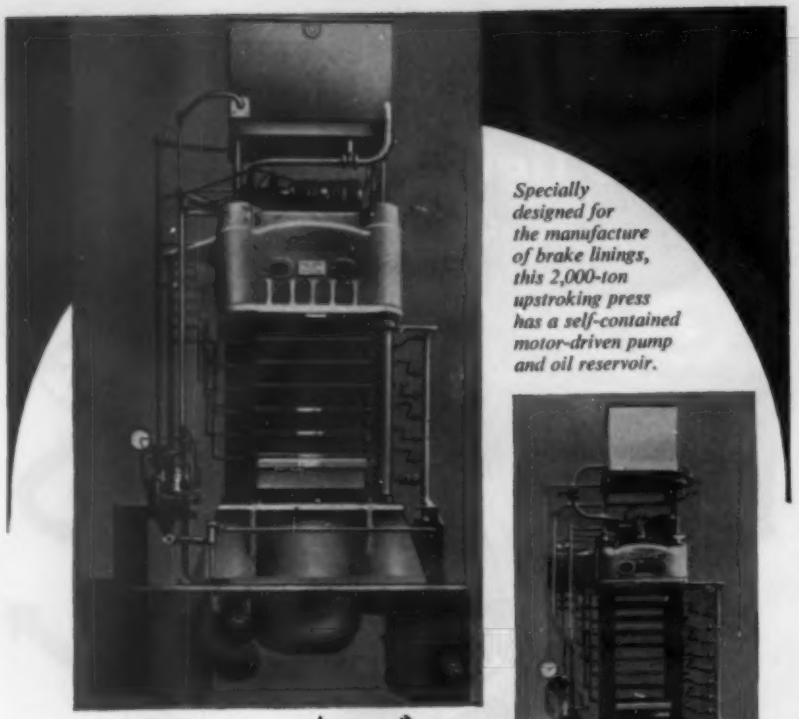
— You can disconnect and reconnect hose lines time after time without leaks — there are no threads to wear out, no tapered seats to groove.

— Cut your production costs — eliminate costly pipe threading operations and separate union and swivel connections.

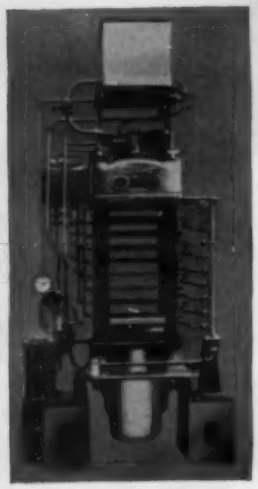
— The patented design of ANCHOR'S Split-Flanges completely conform to S.A.E. Standards.

Write for Anchor Catalog 55 S.F. and get all the facts.

ANCHOR COUPLING CO. INC.
369 North Fourth Street • Libertyville, Illinois
Branch Offices: Dallas, Tex.; Plymouth, Mich.



Specially designed for the manufacture of brake linings, this 2,000-ton upstroking press has a self-contained motor-driven pump and oil reservoir.



A 500-ton upstroking multi-platen press with self-contained pump and oil reservoir.

Fawcett
PRESTON & CO LTD.

specialists in press design and construction

We specialize in the design and manufacture of presses for special purposes and production techniques. Wide experience of the needs of industry enables us to build hydraulic presses for widely varying duties. If you have a special pressing or baling problem, Fawcett technicians can adapt a standard machine to your specifications or, if required, design an entirely new press to fit your production requirements.

A hydraulically operated testing rig with electric motor-driven pump.

FAWCETT PRESTON & CO LTD
BROMBOROUGH CHESHIRE TEL ROCK FERRY 2201 (5 LINES)
A METAL INDUSTRIES GROUP COMPANY

FP8/c/1608

Useful Literature / continued

devoted to the selection and use of resilient sealing materials in which the design of gaskets for various types of applications is discussed and illustrated. Graphs and charts showing deformation of samples under load are presented.

Circle 183 on Reader Service Card

AIR FILTER UNITS . . . manufactured by Arrow Tools, Inc. are presented in a catalog available from the company. Information on automatic combinations including filter, drain trap, regulator, and lubricator and other combinations of units is given. Graphs are included to indicate pressure drop across each unit cate various air flows. For the filters the water removal efficiency at various air flows is shown, and for the lubricators the oil delivery at various air flows is presented. The catalog includes a diagram of a typical installation of the units in an air circuit.

Circle 184 on Reader Service Card

ELECTRIC MOTORS . . . from ½ to 30 hp., single-phase, polyphase, and d-c are covered in Bulletin No. SDA 155 prepared by The Peerless Electric Co. The bulletin gives information on selection of the proper motor, facts about motors, standards and specifications of the company's motors, enclosures, special mountings, and frame sizes are specified.

Circle 185 on Reader Service Card

AIR COMPRESSOR . . . of 125 hp. manufactured by Ingersoll-Rand is reviewed in their Form 3188. Constructional features of the packaged, air-cooled compressor are shown and outstanding data is given. The compressor can be installed with a minimum of foundation time and labor and is easily adapted to either permanent or temporary jobs. Either constant-speed control or dual control can be furnished. Dual control is available with either automatic or manual selection, permitting operation at constant speed or automatic start and stop, whichever is deemed more economical. Having an in-line assembly for reduction of noise and elimination of cones, pulleys, and chains, the unit may be either belt driven or directly coupled to the electric motor.

Circle 186 on Reader Service Card

Circle 19 on Reader Service Card

★ Heavy grey iron casting, accurately machined surfaces.

★ Power factor—15 times air line pressure of 5 to 150 lbs.

★ Throat clearance to center of 18" diam. circle.

★ Ram clearance 0 to 5", stroke 5/8", table 5" x 5".

This useful, high quality No. 80 SPEEDY AIR PRESS is the last word in air power engineering—the result of 34 years of specialization in diaphragm compression. Extremely sturdy, it does dozens of jobs formerly handled by expensive presses—and does them more quickly, easily and economically. Operated by Speedy Foot Control, Hand, or Fingertip Valves. Order from your supplier or write direct.

Write for New Catalog of Speedy Air Tools and Accessories

W. R. BROWN CORP., 2655 N. Normandy Ave., Chicago 35

AIR TOOLS • AIR VISES • AIR REGULATORS • FILTERS • COMPRESSORS

Circle 33 on Reader Service Card

CYLINDERS

Quality without compromise . . .

- The JLE "Work Horse" Cylinder line for air pressures to 110 psi, 250 psi hydraulic. Designed for our own exacting applications on wire machinery, is rugged and dependable. Available in four standard mountings, both cushioned and non-cushioned, in bore sizes 1½ to 10 in.
- The new JLE Square Cylinders for air and low pressure hydraulic service, are available in interchangeable stock mountings, fixed, automatic or adjustable cushions in bore sizes from 1½ to 16 inches.
- Engineering service available for all fluid power problems. Write us or contact your nearest authorized distributor.

Send for new JLE Cylinder Catalog HP 108

JAMES L. ENTWISTLE CO.

1475 Elmwood Ave. • Cranston (Prov. 7), R.I.

Control Gases to 10,000 P.S.I.

WITH VICTOR GAS-O-DOME REGULATORS

Gas pressure, not springs, control diaphragm motion to give you precise regulation of high-pressure gases at high or low flow rates. Can be remotely controlled if desired. Safety valve furnished on request. More than 55 stock models in the following series:

GAS-O-DOME SERIES	DELIVERY RANGE (p.s.i.)	SPECIAL FEATURES	GASES HANDLED
GD 30	0-2500	High Delivery Flow Rates. Accurate Valve Control.	Air, Argon, Helium, Hydrogen, Nitrogen, Oxygen —and others non-corrosive to bronze and stainless steel.
GD 31	0-3600		
GD 61B	0-2500	Excellent Capacity. Compact— 7 lb.— 4" x 6" x 6". —67° to +160° F. Range.	
GD 62B	0-3600		
GD 80	0-5000	Accurate Valve Control. —67° to +160° F. Range.	
GD 81	0-10000		
GD 10	0-500	Self-Relieving Pilot Regulator Control. High Flow Rates.	
SR 10	0-1000	High Pressure, Low Flow. Compact—4 lb. —2" x 6" x 6".	
SR 100	0-30 & 0-40	Corrosion Resistant.	Ammonia (wet or dry) Boron Trifluoride Chlorine (wet or dry) Hydrogen Sulfide, Hydrogen Chloride, Sulfur Dioxide—and other corrosive gases.

VICTOR'S LONG EXPERIENCE IN PIONEERING HIGH PRESSURE GAS REGULATION *is yours for the asking. For details, and complete data on Gas-O-Dome Regulators, see your VICTOR dealer or write us for catalog 341. Dealer inquiries invited.*

VICTOR EQUIPMENT COMPANY

Mfrs. of welding & cutting equipment, hardfacing rods; blasting nozzles; cobalt & tungsten castings.

844 FOLSOM ST. • SAN FRANCISCO 7 21

Post Scripts of Industry

News about people, manufacturers and sales organizations

Loren J. Sewall
Minnesota Rubber & Gasket Co.

Robert W. Phillips
Flex-O-Tube Division

William R. Budd
Emsco Manufacturing Co.

Loren J. Sewall has been promoted to factory superintendent of **Minnesota Rubber and Gasket Co.** In charge of all manufacturing operations, Sewall has been with the firm since 1941. He was previously chief estimator.

Flex-O-Tube Division of Meridan Corporation has appointed **Robert W. Phillips** as chief engineer. Phillips, who is an authority in the hydraulics field, will be responsible for all product engineering, research and development activities. He was previously chief engineer of the Weatherhead Company.

Unisco Inc., have moved their offices to larger quarters at 179 Dyckman Street, New York.

To extend the **Dowty Group's,** England, educational activities, **Kenneth John Hume** was appointed as chief education officer. **Leslie T. P. Banbury,** for many years secretary of Dowty Equipment Ltd., was named a director of the company. **Kenneth A. N. Mills,** until now assistant secretary, has become secretary.

Emsco Manufacturing Company announced the transfer of **William R. Budd** to the Houston office. He will handle engineering and sales of swivel joints in the Mid-Continent. During the last five years he has served in southern California.

Executive offices of **Servomechanisms, Inc.,** previously located in Garden City, New York, have been moved to the company's Eastern and Western Divisions. The Eastern Division is at Post and Stewart Avenues, Westbury, N. Y., and the Western Division at 12500 Aviation Boulevard, Hawthorne, Calif.

J. R. Markey, who joined **Aro Equipment Corporation** in 1939, has been elected a director of the company. His current administrative duties are related to the company's aircraft sales program. **Marquard J. Anderson** has been named a vice president. Associated with the organization since 1945, Anderson has served as assistant to the president for the last three years. **Norman J. Sine** was appointed division manager for western Missouri and will make his headquarters in Kansas City. Until his recent appointment, Sine was district manager for North Carolina.

G. Allen Lovell was elected a vice president of **United States Rubber Company** and appointed general manager of its mechanical good division. Lovell joined U. S. Rubber in 1918 as an apprentice.

Formation of the **J. W. Harvey Company,** La Grange, Illinois, has been announced by **Jack W. Harvey.** The firm will represent manufacturers of portable hydrau-

Continued on page 104

ANNOUNCING THE NEW LINE OF PALLEY HYDRAULIC CYLINDERS

CUSTOM BUILT AT MASS PRODUCTION PRICES

Our 10 years experience in filling the needs of Aircraft and Heavy Industry for Hydraulic Equipment have led us to the engineering and development of this all new line of Industrial Hydraulic Cylinders. Designed especially to meet the most rigid requirements of industry. All are double action with rugged steel construction throughout. Made to take pressures up to 1500 PSI and 3000 PSI. Utilizing standard 'O' rings with leather back-up rings on the 3000 PSI types. Have male clevis mounts on both ends.

We are also equipped to Custom Manufacture to your specifications. Write us Today for further details or expert advice on your problems.

PART NO.	BORE	STROKE	SHAFT	PSI	Type of CAP	THRUST	PRICE
PH34E	3"	4"	1-1/8"	1500	External Threaded	10,500 lbs.	$32.50
PH36E	3"	6'	1-1/8"	1500	" "	"	35.00
PHE1	3"	8"	1-1/8"	1500	" "	"	37.50
PH312E	3"	12"	1-1/8"	1500	" "	"	42.50
PH341	3"	4"	1-1/8"	1500	Inserted	"	32.50
PH381	3"	8"	1-1/8"	1500	"	"	35.00
PH45E	4"	5"	1-1/8"	1500	External Threaded	18,750 lbs.	37.50
PH46E	4"	6"	1-1/8"	1500	" "	"	39.50
PH48E	4"	8"	1-1/8"	1500	" "	"	43.50
PH410E	4"	10"	1-1/8"	1500	" "	"	47.50
PH412E	4"	12"	1-1/8"	1500	" "	"	51.50
PH45E3	4"	5"	1-1/2"	3000	" "	37,500 lbs.	52.50
PH46E3	4"	6"	1-1/2"	3000	" "	"	54.50
PH48E3	4"	8"	1-1/2"	3000	" "	"	58.50
PH410E3	4"	10"	1-1/2"	3000	" "	"	62.50
PH412E3	4"	12"	1-1/2"	3000	" "	"	66.50
PH518I	5"	18"	2"	3000	Inserted	59,250 lbs.	85.00
PH524I	5"	24"	2"	3000	"	"	107.50
PH530I	5"	30"	2"	3000	"	"	130.00
PH636E	6"	36"	2"	3000	External Threaded	86,625 lbs.	265.00

4-WAY, OPEN CENTER HYDRAULIC CONTROL VALVE

Has built-in adjustable relief valve, set at 1000 PSI with a spring loaded neutral position. Used for controlling (1) double action cylinder of the types shown in this advertisement. Can also be mounted in series. Has 3/4" standard pipe inlet & outlet ports. 1/2" pipe thread cylinder port. Shipping weight 10-1/2 pounds. . . . . **21.50 NEW**

NEW-HEAVY DUTY HYDRAULIC CYLINDER

A rugged, heavy duty cylinder. All steel construction. Double action. Has 7" bore. 13" stroke. 2½" steel shaft. Ideal for use in hydraulic presses, leveling ramps, hydraulic tail gates, industrial machinery, road machinery, etc. Shipping weight 180 pounds. . . **95.00**

GB-8-25 TON HYDRAULIC CYLINDER
Same as above except has 8" bore, 15" stroke. Will give 50000 lbs. thrust at 1000 PSI. Shipping weight 185 lbs. **105.00**

SAVE UP TO 85% ON GOV'T SURPLUS

SPECIAL SURPLUS HYD. CYLINDERS

Gov't Surplus Bargain. Produces up to 40,000 lb. thrust with a 3000 PSI line pressure. May also be used as a low pressure air system cylinder. Has a 4" bore, 18" stroke, 30½" length. Part No. 29. New & Used.

NEW **43.95** USED **29.95**

Part No. 27A. Finest Surplus. For use up to 1500 PSI. Has bore of 3½", stroke 21-5/8", shaft 1". Length 29¾". Ports 3/8" AN pipe. **35.77**

Part No. 27B. Similar to above. Will stand up to 2000 PSI. Has internal stroke cushion in both directions. Bore 3-7/8", stroke 23", shaft 1-3/8", eye-to-eye length closed is 40-3/4". Ports are 1/2" AN pipe. **45.00**

Part No. 27C – Similar to 27A above. Take up to 1500 PSI. Has 3-1/2" bore, 23" stroke, 1-1/2" shaft, 34" closed lgth. 1/2" AN pipe ports. **45.00**

HYD. HAND PUMP

12.75

Top condition. Has operating pressure of 1500 PSI. Capacity of 1.5 cu. in. per complete cycle.

HYD. HOSE & TUBING

We stock a complete line of Hydraulic Tubing and Hose as well as all types of fittings and hardware. Send us your requirements.

TELESCOPING HYDRAULIC CYLINDER

Thrust shaft is in two stages. First stage extends 39" – the second stage extends 18". Each stage works seperately. The overall length eye-to-eye is 61½". Inner shaft is 2-3/4" dia. outer shaft is 3¼" dia. Bore is 4¼". Ports are 1/2" AN pipe. **165.00**

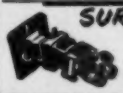
COST GOV'T APPROX. $6000 **$1495**

AIR ASSOCIATES HYDRAULIC TEST STAND

Electric motor driven type. Has a 2500 PSI Hydreco Pump which delivers up to 10 GPM. Powered by 15 HP, 3 phase motor using 220/440 volt, 60 cycle current. Unit has selector valves, pressure gauges, flow meter, reservoir, heat exchanger and filter pressure regulator. Mounted on steel frame. Has work bench, flourescent lights and hand operated, high pressure pump for testing to very high pressures. Overall size: 8ft. long x 7ft. high x 4 ft. deep.

HYD. TEST STAND – Same as above but has a Reeves variable speed reducer to control the pump output as desired. **$1895**

SURPLUS VICKERS PISTON TYPE-CONSTANT SPEED-HYD. PUMPS & MOTORS



Made to top Aircraft specifications. RPM shown below is the recommended maximum for constant speed. Quantities limited.

Part No.	Cu. in. per rev.	GPM	PSI	RPM	PRICES NEW	PRICES USED
HYDRAULIC PUMPS						
PF9-713-20BCE	.410	5.3	1000	3000	—	$20.00
PF9-2713-20ZE	.410	5.3	1500	3000	$24.50	—
PF9-2713-10Z	.208	2.7	1500	3000	$29.75	$22.50
PF2-713-25BCE	.507	6.5	1000	3000	$32.50	$22.50
PF50-3915-30YG	1.520	19.7	3000	3000	—	200.00
HYDRAULIC MOTORS						
MF9-713-15A	.310	4.46	1000	3750	—	$18.50
MF9-713-30BCF	.600	9.75	1000	3750	$37.50	—
MF2-713-25BCF	.507	8.25	1000	3750	—	$22.50

STRATO POWER HYDRAULIC PUMPS

Designed and built to finest aircraft specifications.

PART NO.	GPM	PSI	RPM	PRICE EA.
SP-3	2	1400	3750	NEW $27.50
67WF300	3	1500	4500	USED 72.50
67WJ800	8	3000	4500	USED 87.50

Order from this Ad. Pay by Money Order or Check. P.O.s accepted from well rated D&B firms. 1/2 Dep. with C.O.D.s. Prices F.O.B.

Palley SUPPLY CO

2263 E. VERNON AVE., DEPT. AH-8 LOS ANGELES 58, CALIFORNIA

NEW 10 TON HYDRAULIC PRESS

Here is a rugged 10 TON Arbor Press you can use in the shop or take with you on the job. Has sturdy frame of 4" welded channel iron. Press has 4-1/4" stroke, 2-1/2" diameter ram. A control valve operates the piston in both directions. Platform is adjustable. Has positive power Hand Pump. 2000 PSI pressure gauge. NEW **129.00**

NEW SURPLUS VICKERS HYDRAULIC TRANSMISSION

Self-contained, constant torque at all speeds with variable volume, reversible piston pump which supplies hydraulic motor. Has 2 H.P. automatic pressure dash pot for smooth control. Power output RPM is 0 to 1/3 input RPM in both directions. Input RPM 1800 continuous, 4000 intermittent. Ideal for Lathes, Duplicator set-ups, Conveyors, Drives, etc. . . . **44.50**

4" SPLINE SHAFTS for input and power take-off on above. $2.50 pair

INPUT & TAKE-OFF PLATE ASSEM. To adapt trans. to pulley drive. Has high speed bearings and 1/2" keyway shaft. Per Set **20.00**

PESCO HYD. PUMP

A gear type pump. Will deliver 2 GPM at 1500 RPM with 1500 PSI – delivers 6 GPM at 4300 RPM with 1500 PSI. Has .375 cu. in. displacement per rev. Ports are 3/4" standard pipe. 5/8" male spline drive shaft. 4" pad mount. In good condition. **14.95**

NOTE: Items shown here are only a small part of our tremendous stocks. We have over 100,000 Hydraulic Cylinders in 186 sizes and types. Also all type Valves, Pumps, Motors.

Circle 24 on Reader Service Card

What he needs is a

STAFFA HYDRAULIC RAM!

Staffa Rams are available in four standard ranges: high and low pressure solid, high pressure hollow and tubby rams. Loads from 1 to 150 tons. Pressures up to 5,000 p.s.i., strokes up to 36". Higher pressure and larger stroke rams are made specially.

For rams, pumps and all other hydraulic equipment write to Chamberlain Industries Ltd., Staffa Works, Staffa Road, Leyton, London, E.10.

For pulling, pushing, lifting, pressing, clamping, bending or spreading.

CHAMBERLAIN INDUSTRIES LTD.

Staffa Works, Staffa Road,
Leyton, London, E.10, England.
Telephone: LEYtonstone 3678.

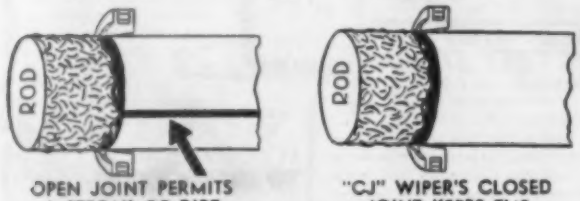
Post Scripts of Industry
continued

lic tools and components. Harvey was formerly general sales manager for the Manco Mfg. Co.

Jack W. Harvey
J. W. Harvey Company

Control Equipment Company, Atlanta, Georgia, was named exclusive sales representative for the **Cuno Engineering Corporation.** Headed by **Robert P. Saunders** and **Charles L. Saunders,** the company will cover

This or This?



OPEN JOINT PERMITS A STREAK OF DIRT AT JOINT OPENING

"CJ" WIPER'S CLOSED JOINT KEEPS THE ENTIRE ROD CLEAN

For those dry operations requiring absolute freedom from dust or dirt passing through joint of ring to bearings or packings, we have especially designed—the

FALL WIPER RING with Closed Joint
(our P/N-FWR-CJ)

In addition to the above, and since 1944, we have also manufactured **For Army and Navy Use the 3 Piece FALL WIPER RING FWR-3C**

Spec. Mil-S-5049, AN Approved, Military part numbers from AN6231A1, 1/2", to AN6231A71, 13", diameter. This ring consists of 3 pieces assembled into one . . (1) a one-piece Split Wiper Ring (Body) with 2 flanges or groove in its O.D.; (2) a one-piece split compressor spring assembled in groove (3) and endless cover band surrounding spring in groove which causes squeeze grip action on piston rod.

Squeeze Grip Action Does It—patented

—and squeeze grip is always the same because uniform tension of spring under endless cover band. Rods or pistons do not stick or become immobile in ANY temperature.

Our engineers will gladly work with you on any wiper ring problem. Write, wire or phone us.

Ace Products Co., Toledo 1, Ohio

Fall Wiper Ring SPRING LOADED

Phone Adams 6513
Covered by patents issued and patents pending.

Gresen
HYDRAULIC CONTROL VALVE
(Directional)

Model S.P.

- For Single or Double Acting Cylinders
- Pressures to 1500 PSI
- Built-in Adjustable Relief
- Ball Checks
- Openings—1/2" cylinder ports, 3/4" inlet and outlet.

Write for literature

GRESEN MANUFACTURING CO.
628 Colfax Ave. N. Dept. A-55 Minneapolis 11, Minn.

Circle 1 on Reader Service Card
Circle 39 on Reader Service Card

Georgia, all of Florida except the northwest portion, eastern Tennessee and two counties in South Carolina. Cuno also appointed **George S. Edwards,** Birmingham, Alabama, as sales representative. His territory includes Alabama, parts of western Florida and central Tennessee.

Waterman Engineering Company has negotiated an exclusive contract with **Pneu-Draulics Engineering Company,** established by **Eric J. Saville** and

Eric J. Saville
Pneu-Draulics Eng. Co.

Raymond S. Hunt, Jr.
Pneu-Draulics Eng. Co.

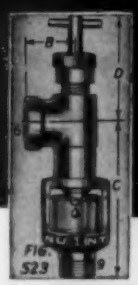
Raymond S. Hunt, Jr. Both men were previously associated with Vultee Aircraft Corporation. The company will specialize in the design and development of airborne hydraulic and pneumatic equipment.

Vernon R. Quimby has been named division manager of the **Industrial Associates Division of Dumont Aviation Associates.** This new division, of which

Continued on next page

See...Don't Guess

Install NUGENT Sight Feed Valves for LUBRICATION CONTROL



13 models designed for working pressures to 125 psi. Sizes to ¾ inch.

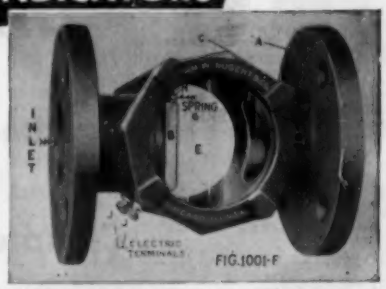
9 models for large machinery. "Swivel and lock" type for sight chamber adjustment to most convenient view position.

Medium size needle type with steel valve stem. 9 models. Sizes to ¾ inch.

WITH a Nugent Sight Feed Valve in your oil line, you can tell at a glance whether or not vital parts are receiving proper lubrication. Nothing is left to chance and there's no guess work involved. Oil flow through the valve is controllable from 2 drops per min. to 21 gals. per hour depending upon oil viscosity and valve model. All are vented to prevent air binding. Glasses and screens are removable for cleaning without interrupting oil flow.

SIGHT FLOW INDICATORS

ANOTHER NUGENT instrument for solving lubrication problems is the Sight Feed Indicator. Installed in a machinery oil system, this device sounds an alarm when oil is not getting to bearings. When oil is not flowing properly, Indicator "B" (See Fig. 1001-F) closes making contact with terminals "J". This sounds the alarm making it possible to locate trouble quickly, protect valuable machinery and save on costly down time.



Sight Flow Indicator available with tapped or flanged connections. Removable windows. Can be installed right or left hand or vertically.

For trouble free lubrication systems, write for descriptive bulletin on the Nugent Sight Feed, Sight Flow Indicator and other Lubrication Specialties.

Wm. W. Nugent & Co., Inc.
421 N. Hermitage Ave. CHICAGO 22, ILLINOIS

OIL FILTERS, OILING AND FILTERING SYSTEMS, TELESCOPIC OILERS, OILING DEVICES, SIGHT FEED VALVES, FLOW INDICATORS

Established 1897

Post Scripts of Industry
continued

Quimby will be the operating head, will specialize in airframe and accessory replacement parts.

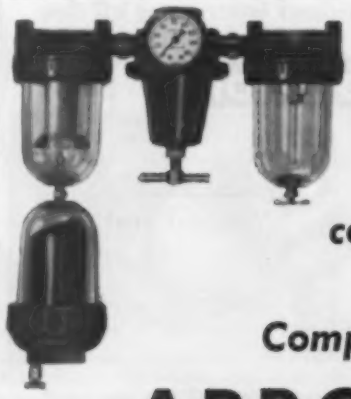
The Hammel-Dahl Company has appointed the **MacGuire Instrument Company,** Cayce, South Carolina, as their new sales and service representatives. The company will cover South and North Carolina and part of Virginia. **William J. MacGuire,** will be in active charge of sales and service.

Metal Goods Corp., Houston, Texas, was named as distributor for Parker Appliance Company's re-usable fittings. **H. T. Gregg,** vice president, states that the company will stock a wide range of fittings.

Decision that **The Hydraulic Press Manufacturing Company,** Mount Gilead, Ohio, will continue as an independent company was recently announced by **G. B. Robinson,** chairman of the board. Five key executives, who will carry out the new policy decisions reached, were named. **William H. Bennett,** vice president in charge of sales. Bennett first joined HPM in 1939, later served as assistant general sales manager and director of engineering. He became sales manager of Lake Erie Engineering Corporation some months ago, and now returns to an executive position. **J. W. Arnold,** vice president in charge of manufacturing, was previously general manager of the

William H. Bennett
Hydraulic Press Mfg. Co.

Robert J. Lindsey
Hydraulic Press Mfg. Co.



ARROW

for control and conditioning of Compressed Air

ARROW

Autopneumatic Control Assembly or Individual Units

Filters—Lubricators—Regulators—Water Traps

Will reduce maintenance, repair and down time to the minimum for all Air Power Tools and Appliances.

Pipe Line Sizes: 1/4", 3/8", 1/2", 3/4", 1" and large capacity.

Write for new CATALOG and Literature

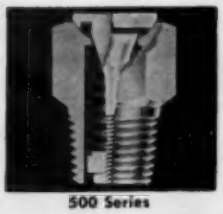
ARROW TOOLS INC.

1902 S. KOSTNER AVE. CHICAGO 23, ILL.

Continued Progress in Valve Efficiency

now— A COMPLETELY RELIABLE

RELIEF VALVE!



500 Series

- Doesn't leak
- Reseats dead tight
- Doesn't stick

Send for information today..... ☐

OTHER CIRCLE SEAL VALVES

• Check Valves • Shut-off Valves • Shuttle Valves

CIRCLE SEAL *precision valves*

Representatives in Principal Cities.

JAMES•POND•CLARK

2181 East Foothill Boulevard, Pasadena 8, California

Circle 10 on Reader Service Card

Circle 47 on Reader Service Card

Erie Engine and Manufacturing Co. **William N. Woodward,** secretary-treasurer, has been with the organization for some years, has been controller and assistant secretary since 1950. **Robert J. Lindsey,** director of engineering, first came to HPM in 1940. Lindsey left in 1950 to join Elmes Engineering Division of American Steel Foundries as chief engineer, and has now returned. **Glen R. Pittman,** sales manager-Hydraulic Power Division, has been associated with the firm since 1938, apart from a short period with Cemco Industries, Inc. He will now be responsible for the sales of all components and power units manufactured by this division.

Glen R. Pittman
Hydraulic Press Mfg. Co.

The promotion of **Joseph J. Jenkins** to sales manager of the **Lincoln Engineering Company's Industrial Division** has been announced. Jenkins, who has been associated with the company for 15 years, has served as National service manager and as assistant to the industrial sales manager.

James W. Foley has been elected as executive vice president of **The Texas Company.** Foley, elected a vice president early in 1953 and a director in September 1954, is also a director of Arabian American Oil Company, the Trans-Arabian Pine Line Company, Tex-

Continued on next page

IF YOU HAVE A "DOWN-TIME" PROBLEM—why not get the RIGHT ANSWER at a cost that will not show up on your ledger—until you are satisfied

Briggs PIONEERS IN MODERN OIL FILTRATION

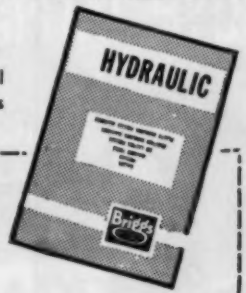
has served
GISHOLT MACHINE CO.
for many years
and here is what they say

"We use Briggs clarifiers to purify the oil for operating all our hydraulic speed selectors. Briggs is standard on all of our ram and saddle type turret lathes. With Briggs the improved performance has more than offset the cost."

IF YOU MAKE OR USE HYDRAULIC EQUIPMENT we have a NO COST TRIAL PLAN that will interest you. Write today for complete information on

Briggs PIONEERS IN MODERN OIL FILTRATION

HYDRAULIC OIL FILTERS
with interchangeable cartridges for mineral oils, additive oils or non-inflammable fluids —for by-pass or high flow installation.



THE BRIGGS FILTRATION COMPANY, Dept. 64
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Post Scripts of Industry

continued

aco Exploration Company, Columbian Petroleum Company, South American Gulf Oil Company, Coltexo Corporation, and The Texas Company (Iran). He joined The Texas Company in 1932, served in various capacities and was appointed assistant to the chairman of the board in 1950.

Harvey P. Barnes has joined **S. G. Morris** and will handle sales and service in Summit and western Cuyahoga Counties of Ohio. Barnes has had nine years experience in the air and hydraulic field.

Industrial Piping Supply Co., Charlotte, North Carolina, has been appointed a franchised distributor for hydraulic hose and re-useable fittings manufactured by Parker Appliance Company.

Charles J. Wallace
Houdaille-Hershey of Indiana Inc.

Charles J. Wallace has been elected vice president and general sales manager of **Houdaille-Hershey of Indiana, Inc.** Wallace, who comes from the parent Houdaille-Hershey Corporation, has had extensive experience in virtually every phase of the filtration industry.

Earle L. Kneifel has been appointed sales representative for **Marsh Instrument Company** in the Pittsburgh, Pa., area. He will cover the territory of southwestern Pennsylvania extending as far east as Juniata County. Before joining Marsh, Kneifel was associated with North American Aviation.

Earle L. Kneifel
Marsh Instrument Company

Metal Industries Limited, England, has appointed **J. O. Knowles,** chairman and joint managing director of Brookhirst

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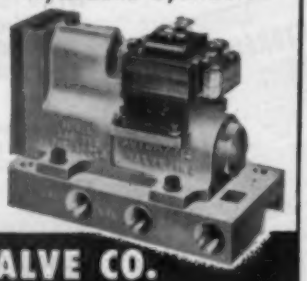

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Circle 99 on Reader Service Card

Switchgear Ltd., **J. T. Rymer,** managing director of Sentinel (Shrewsbury) Ltd., and **Sir Charles Westlake,** present chairman of Uganda Electricity, to the board of directors. **J. S. Hutchison** has been appointed as chairman to succeed R. W. McCrone, who has retired after 33 years.

The Rucker Company has named **Thomas B. Morrow** as division sales manager for northern California, Oregon, southern Idaho and Nevada. A Stanford University graduate, Morrow was previously associated with the F. L. Jacobs Co., Detroit.

Thomas B. Morrow
The Rucker Company

John A. Jost has joined **Kewanee Ross Corporation, Ross Heater Division,** as heat exchanger development engineer. He was for 18 years associated with Foster-Wheeler Corp. where he specialized in heat exchangers.

John A. Jost
Kewanee-Ross Corporation

A. B. Copeland has become midwestern sales manager for **Cook Electric Company.** He was previously manager of Airframe Supply Company and also was associated with Gits Bros. Mfg. Co.

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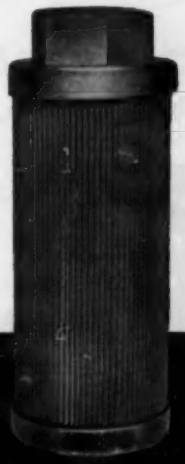

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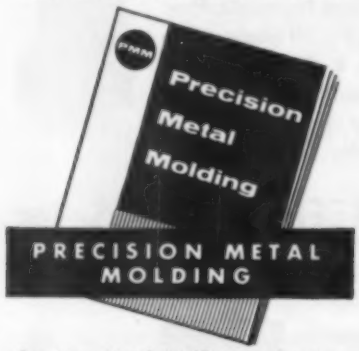

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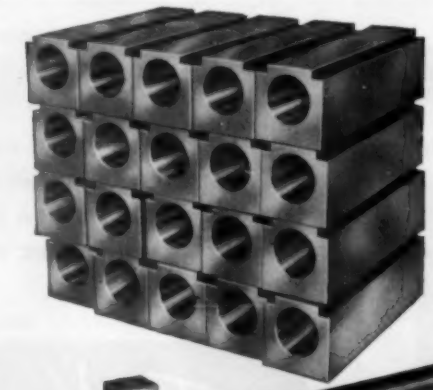

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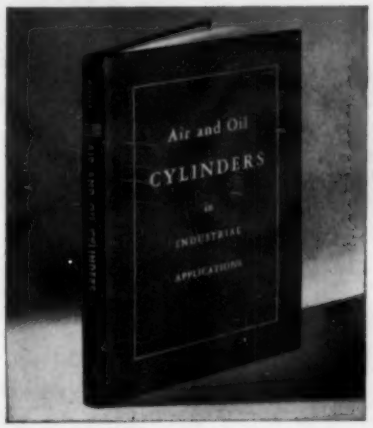

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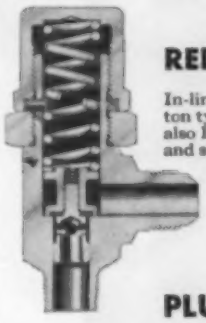

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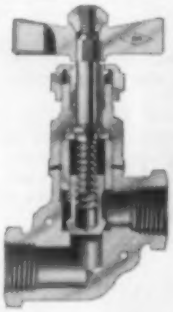

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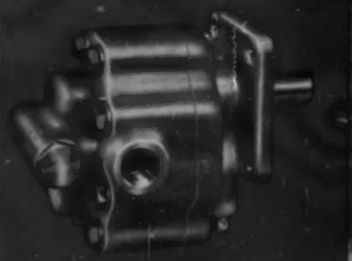

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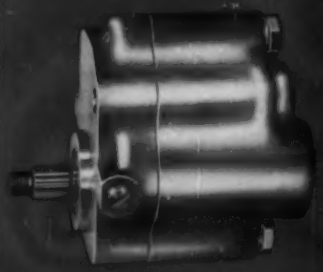

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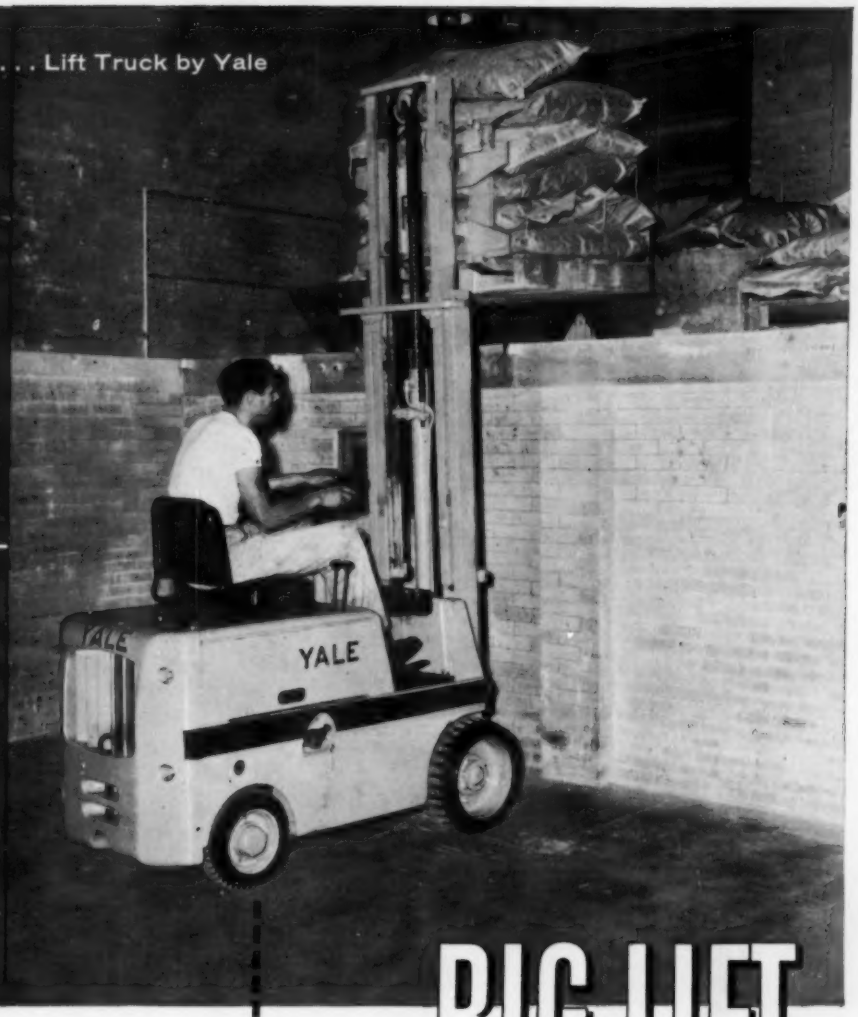

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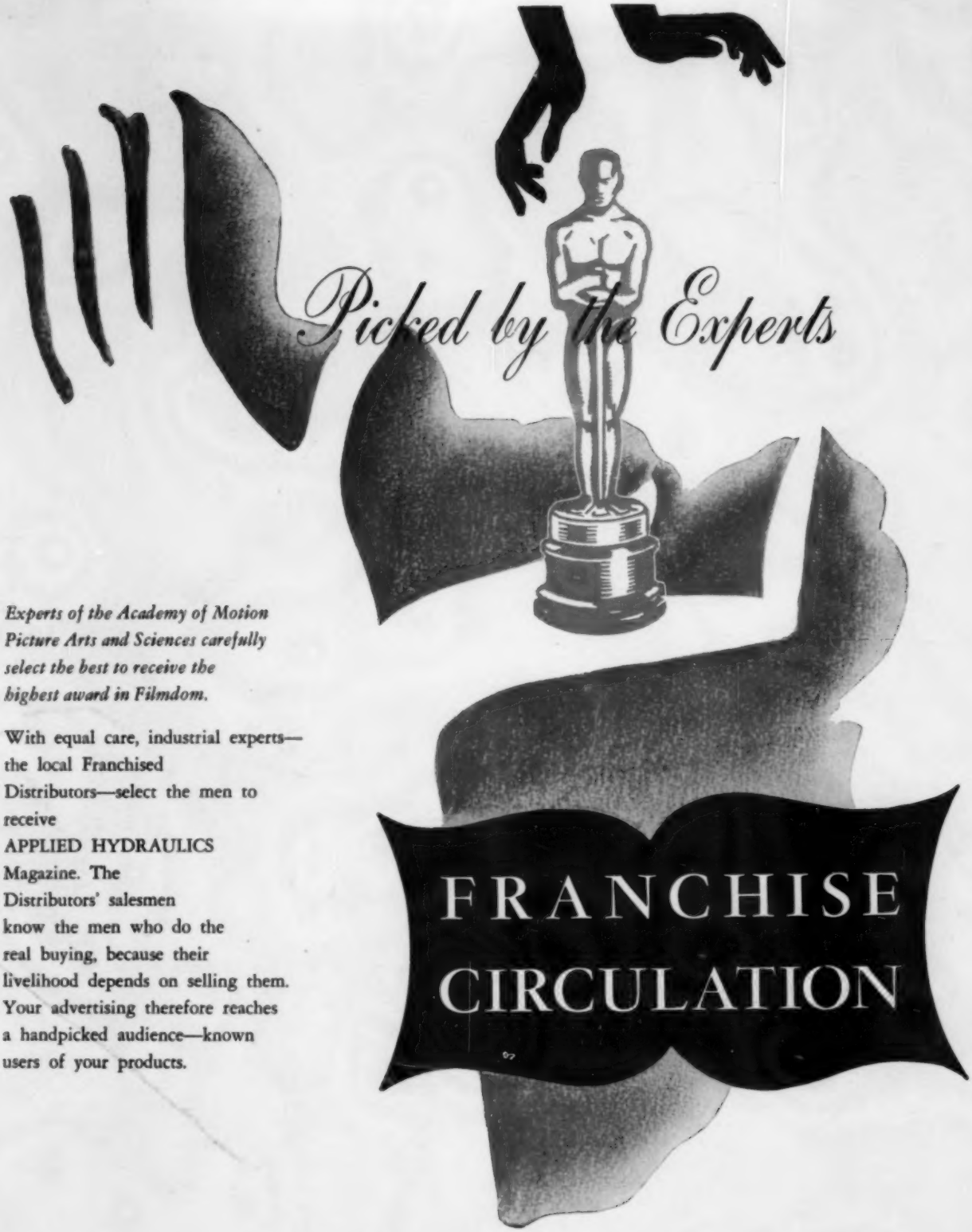

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